AMERICAN ENGINEER AND RAILROAD JOURNAL.

MARCH, 1902.

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AMERICAN ENGINEER TESTS.

Locomotive Draft Appliances.

VI.

TESTS OF LOCOMOTIVE STACKS.

Report by Professor W. F. M. Goss, of Purdue University.

Section 1, Continued from Page 35.

4. The Variables.—The plan, as outlined, and as approved by you before the beginning of the work, involves a study of the effect produced upon the efficiency of the draft action by certain definite changes in the mechanism of the engine and in the conditions under which it is run. Factors which by the outline of the tests are subject to change are as follows:

a. Form of Stack.—With reference to this factor, two contours only were provided, one straight and one tapered, of the general form disclosed by Figs. 2 and 3, respectively. (See American Engineer, page 35, February number.)

b. Diameter of Stack.—Each form of stack was developed into a series of different diameters, the diameters being 9¾ ins., 11¾ ins., 13¾ ins. and 15¾ ins., respectively. The dimensions given apply to all portions of the straight stacks above the base, and to the least diameter of the tapered stacks. It is the understanding of the undersigned that the reasons which influenced Mr. Vaughan in the selection of the diameters chosen are to be found in the fact that they are in close agreement with the diameters used in the von Borries-Troske experiments.

c. Height of Stack.—Each of the eight stacks already described was made in five sections, the upper four sections each being 10 ins. in height. This provision makes it possible to employ either of the eight stacks in heights varying from 16½ ins. to 56½ ins.

d. Exhaust Nozzles.—It was not expected that the work should involve any investigation of exhaust pipes or nozzles, this phase of the draft appliance problem having been very thoroughly covered by the Committee of the Master Mechanics' Association, working under the inspiration and direction of Mr. Robert Quayle. It was assumed, however, that in order to get the maximum efficiency of each different diameter and height of stack it would be necessary to provide a variable height of nozzle. This was done in the manner indicated by Fig. 4. The nozzle shown, therefore, provides means for testing each stack with nozzles of different heights.

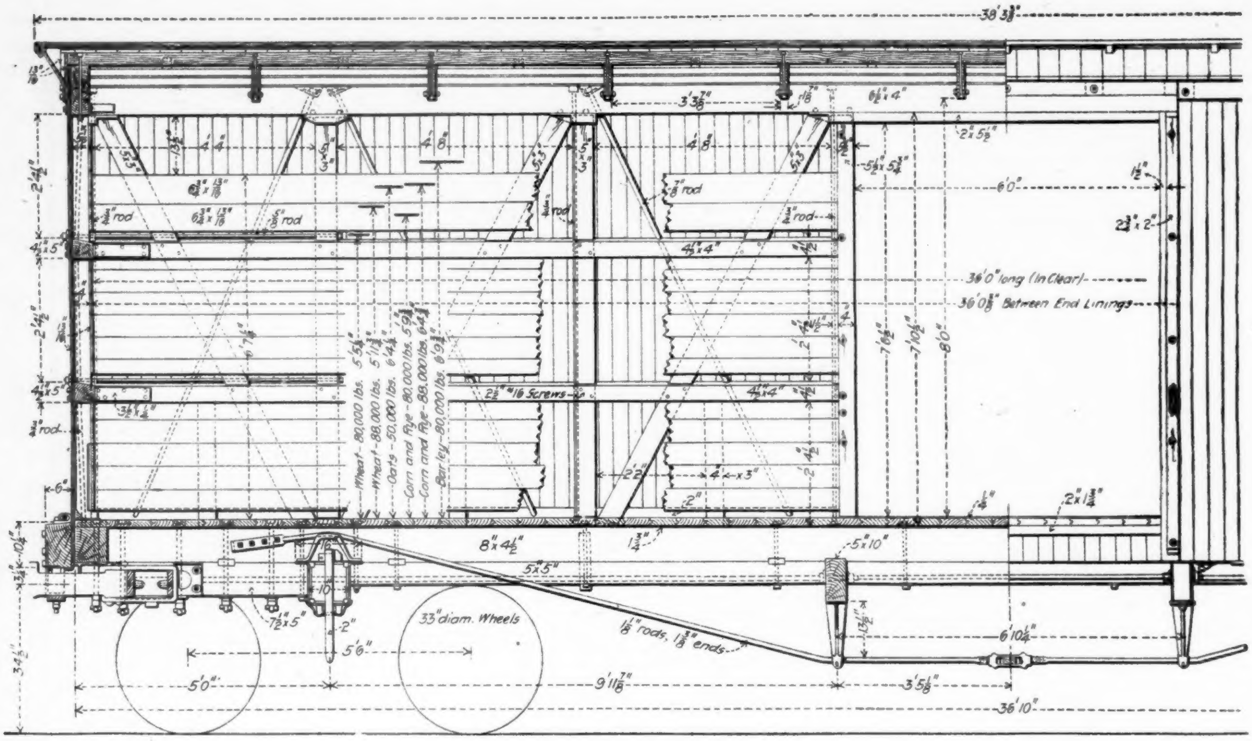
e. Power of the Locomotive.—In the early discussion of the matter, the question arose as to whether a combination of apparatus which would give the highest efficiency when the engine was worked at light power, would prove the most efficient under conditions of heavy power, and that there might be no question arising from this source it was determined to make tests under each combination of apparatus, with the engine running at three different rates of power. It was determined, also, that this could best be accomplished by running all tests under a constant steam pressure, a fixed cut-off, and a wide-open throttle, the desired variations of power being obtained by varying the speed. The conditions chosen were approximately as follows: Steam pressure 180 lbs., cut-off of 1-3 stroke, speeds for different power 20 miles, 30 miles and 40 miles, respectively; the power under these conditions being approximately 260, 370 and 475. The amount of steam generated by the boiler, and discharged from the exhaust tip, varies nearly in direct proportion to variations in power.

5. The Measure of Efficiency.—Following the practice of the Master Mechanics' Committee, the efficiency of each individual arrangement has been judged by the value of the ratio of the reduction of pressure in the smokebox to the back pressure in the steam passage between the cylinder and the exhaust pipe. Thus, calling the reduction of pressure in the smokebox "draft," and the pressure in the exhaust passage "back pressure," the efficiency is

$$\text{Efficiency} = \frac{\text{Draft}}{\text{Back pressure}}$$

This measure is based upon the assumption that the result, which is sought by use of draft appliances, is a reduction of pressure within the front end, and that the force necessary to be expended in securing such a result is represented by, or is a function of, the back pressure between the cylinder and the exhaust tip. Consequently, other things being equal, that arrangement of apparatus which will give the desired reduction of pressure in the front end for the least back pressure is the most efficient. To be entirely logical, both the draft and the back pressure should be expressed in units of the same value, though this is not necessary where results are for comparisons within themselves.

6. Methods.—It is well known that the draft, as measured by a reduction of pressure within the front end, is affected by conditions other than those which control the action of the steam jet. With the force of the jet remaining constant, the draft will vary with every change in furnace condition which serves in any way to affect the freedom with which the air is permitted to move through the grate and firebox. Thus, all other things remaining constant, the draft is reduced by opening the fire door, and increased by closing the ash-pan dampers. Similarly, a thin, clean fire, which offers but little resistance to the passage of air, results in light draft, while a thick, heavy fire, which impedes the movement of air at the grate, increases the draft. This being true, and since the draft is a factor in our accepted measure of efficiency, it follows that the observed efficiency of any given detail in the front-end arrangement will be affected by any variation of conditions at the grate. The present purpose is concerned entirely with the stack and the dependent mechanism within the front end, and that observations in connection with these need not be affected by complicating conditions elsewhere, it has been deemed essential to provide for constant conditions at the grate. As this could not be done in connection with solid fuels, the experimental engine was equipped for burn-



80,000 Lbs. Capacity Box Car.
New York Central & Hudson River Railroad.

ing oil, the air openings into the firebox being so arranged that they would at all times be of fixed dimensions; the degree of ease, therefore, with which air finds its way into the furnace is unaffected by the condition of fire. The fuel used was Lima oil. Acknowledgements are due Mr. C. W. Owston, representing the Standard Oil Company, for courtesies received in connection therewith.

In work previously carried on at Purdue the draft has been obtained by means of a U-tube connecting with a pipe extending into the smokebox just back of the diaphragm. Before undertaking an investigation so formal as that with which this report deals, it seemed best to consider whether such a location of the draft gauge gave a representative value for the reduction of pressure in the front-end, or whether the gauge itself might not be affected by conditions of running, independent of the normal pressure existing in the front-end. The question having been raised, it seemed best to make a preliminary survey of the front-end to determine what is the condition of pressure throughout every part, with the expectation of finally locating the draft-gauge at a point which could be accepted as satisfactory. The results of this investigation and the conclusions derived therefrom constitute the subject of another section of this report.

The steam pressure within the exhaust passage of the saddle has been determined by means of a U-tube filled with water or mercury, and checked by a Bristol pressure-recording gauge. As a further check on this reading, specially prepared indicators were attached to the right cylinder. These indicators were supplied with ten pound springs to permit the back-pressure line to be drawn at large scale, and adjusted in such a manner as to prevent injury to the indicator during the effective stroke of the piston.

7. Limiting Conditions.—The concluding portion of the preliminary work consisted in a study of the effect upon the experimental study, of limitations upon the height of stacks as disclosed by existing designs. For example, the limits which conditions of service place upon the height of the stack, necessarily limit the range affecting the relative position of all other parts within the front-end. It was thought that in the experimental work there would be no need to include conditions which could not under any circumstances be applied on the road. For this purpose information was sought from those having large boilers in service, concerning the dimensions of the several parts entering into the draft arrangement, including height of nozzles and of stacks. A study of data thus obtained has been made by Professor Forsyth, with conclusions which are presented in a succeeding section.

(To be continued.)

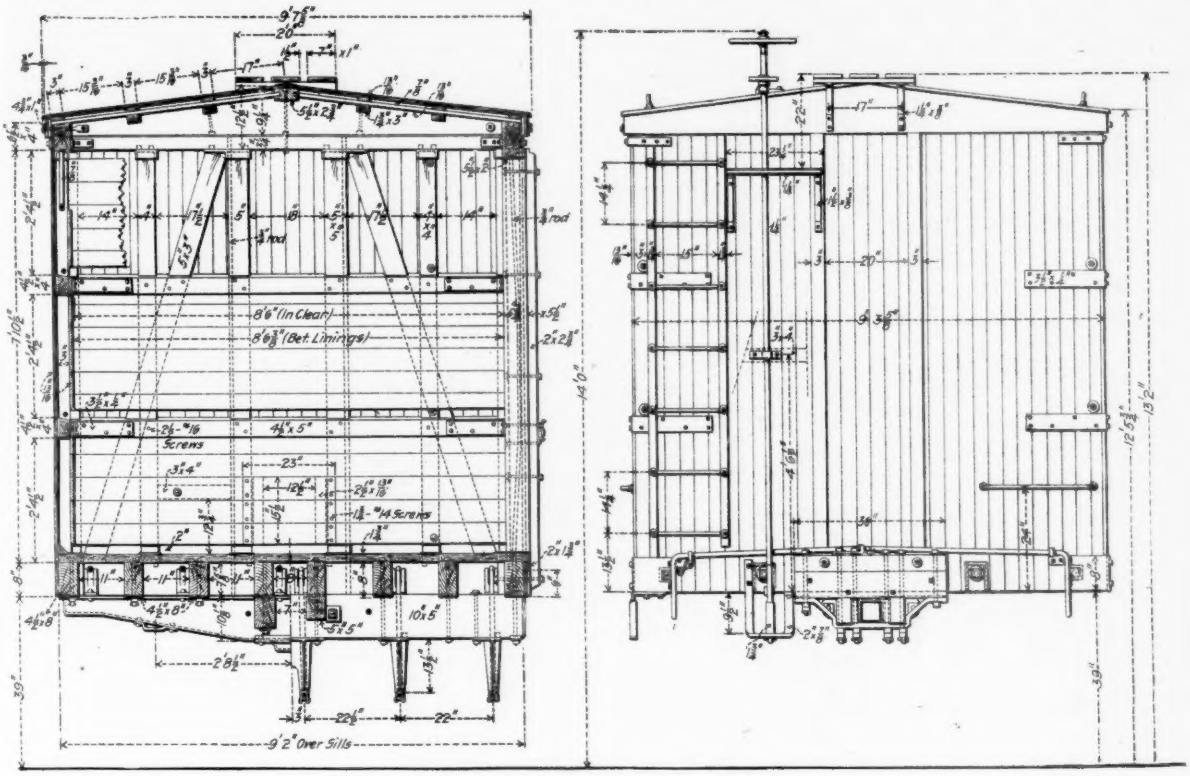
80,000-LB. CAPACITY BOX CAR.

New York Central & Hudson River Railroad.

Built to Standard Interior Dimensions.

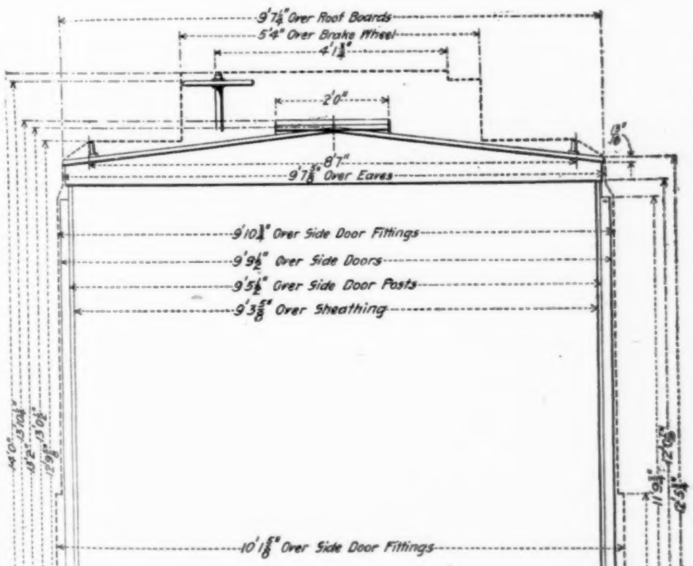
Through the courtesy of Mr. A. M. Waitt these engravings have been prepared to illustrate the new standard 36-ft. box car for this road, which is an interesting and important design in view of the fact that it covers the requirements of the standard inside dimensions and comes within the clearance limits of the Eastern roads, which are important in interchange of equipment. Furthermore, the construction is such as to avoid cutting the end sill for the shank of the coupler. This becomes important in the case of wooden underframes, although there is less objection, because of the weakening of the sills, when the underframes are of steel. This disposition of the coupler permits of retaining the usual height of the floor and the real difficulty is then transferred to the eaves, where close figuring is required to keep the width within the necessary limits. With this construction some care was required to secure sufficient room for a proper depth of the bolster. In this case the body bolster is 10⅛ ins. deep, which has been used satisfactorily under 40-ton cars, and either pressed steel or arch bar trucks may be used. These cars will have trucks of the former type.

Drawings for a car of this capacity had been completed when the standard interior dimensions were adopted by the American Railway Association, and after the announcement of the standard the dimensions were changed to those shown



80,000 Lbs. Capacity Box Car.

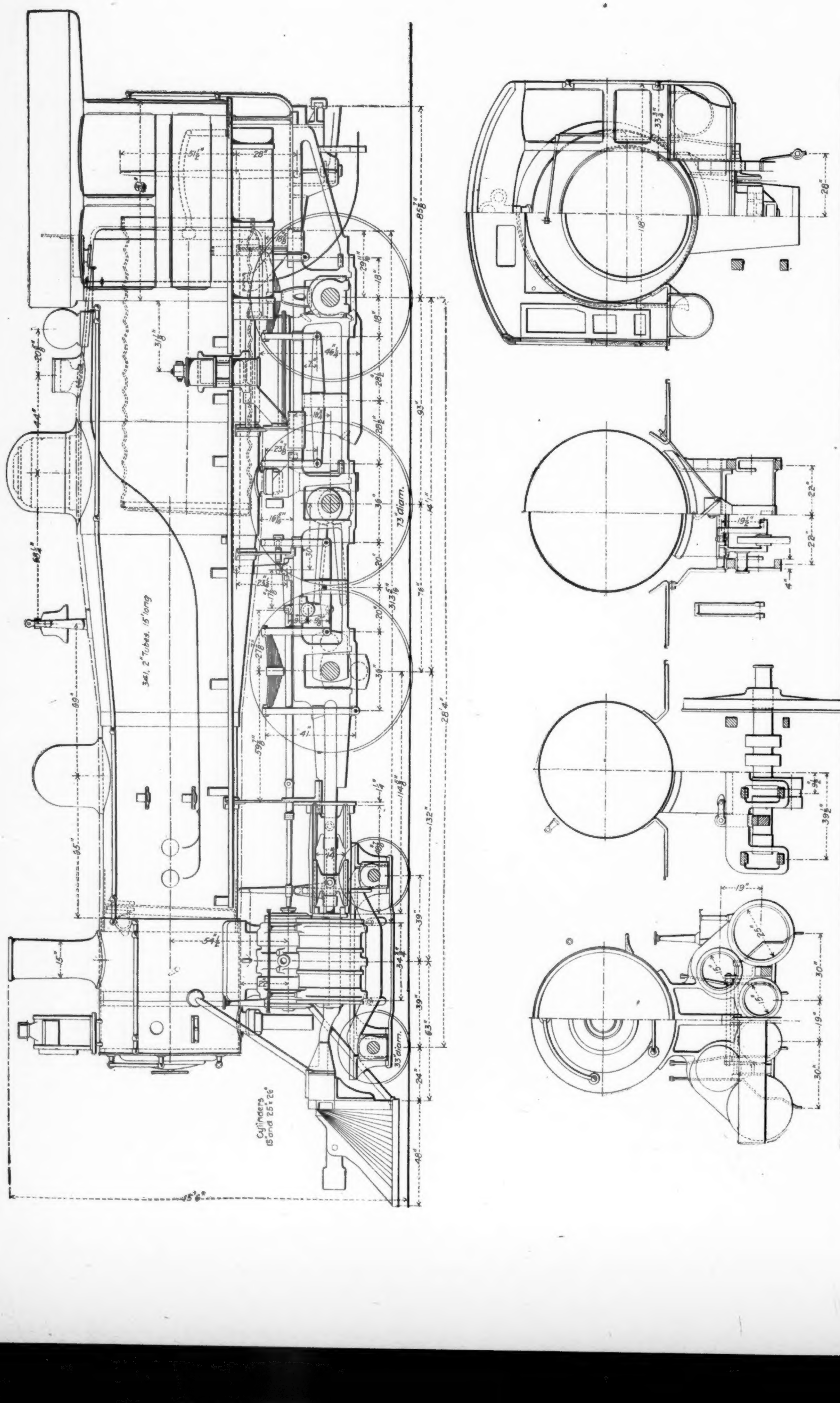
New York Central & Hudson River Railroad.



Clearance Diagram, 40-Ton Car.
New York Central & Hudson River Railroad.

in these engravings. These include a 6-ft. door opening, and the usual number of side posts was retained in order to avoid bringing the bracing too near to the vertical. It will be seen that the needle beams have been placed under the door posts to give them substantial support. All the posts and braces have cast-iron pockets at both ends, and instead of using tie rods between the plates the carlines and plates are connected by joint bolts.

The distance from the top of the rail to the upper face of the floor is 4 ft. ¾ in., which is but ¾ in. more than that recommended by the circular from the committee of the Master Car Builders' Association. At a height of 12 ft. 6¾ ins. above the rail the width of the New York Central car at the eaves is 9 ft. 7⅝ ins., or but ¼ in. more than the distance recommended by the committee. Otherwise the dimensions of the car meet the recommendations of the committee. While the slope of the roof is less than that of earlier cars on this road it has less pitch than that proposed by the committee, which was done in order to secure a minimum clearance of 20 ins. over the running boards of the cars for the home road. These cars have "Security" doors with no shields over the door rails. Only very thin metal shields could be used, and they were omitted entirely, the upper joint between the door and the car body being water tight without further protection. Winslow roofs and malleable iron draft arms are used. The engravings have been prepared with special care to illustrate the details of the construction. The clearance diagram indicates the cross-section of the car with the dimensions conveniently arranged for comparison with the clearance diagrams of other roads. It would be well for all roads to prepare these diagrams if they expect to interchange equipment with the Eastern lines with restricted clearances. We printed a similar cross-section for the New York, New Haven & Hartford on page 17 of the January number.



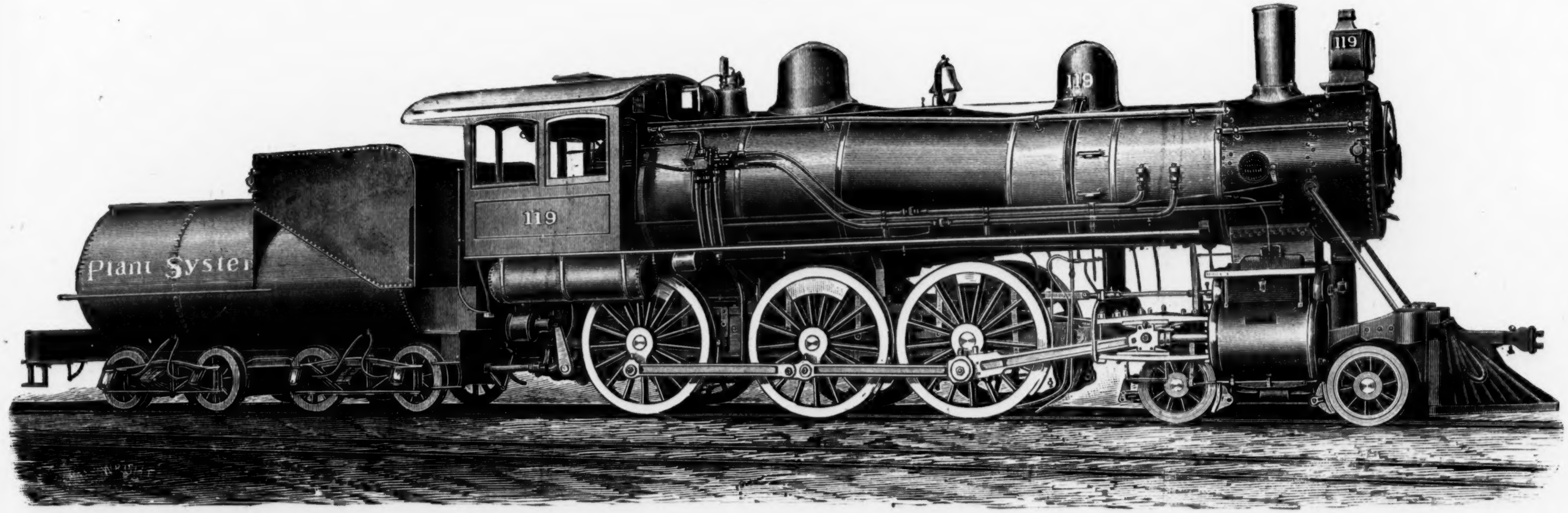
W. E. Symons, *Superintendent Motive Power.*

Baldwin Locomotive Works, *Builders.*

Compound Ten-Wheel Passenger Locomotive, Plant System of Railways.

Vauclain Four-Cylinder Balanced System, with Vanderbilt Boiler and Tender.

THE 20,000TH LOCOMOTIVE BUILT BY THE BALDWIN LOCOMOTIVE WORKS.



Ten-Wheel Compound Passenger Locomotive—Plant System of Railways.

W. E. Symons, Superintendent of Motive Power.

Vauclain, Four Cylinder Balanced System, with Vanderbilt Boiler and Tender and Symons Steel Truck.

THE 20,000th LOCOMOTIVE BUILT BY THE BALDWIN LOCOMOTIVE WORKS,

Philadelphia, Pa., U. S A.

COMPOUND TEN-WHEEL PASSENGER LOCOMOTIVE.

Vauclain Four-Cylinder Balanced System.

Plant System of Railways.

The 20,000th Locomotive Built by The Baldwin Locomotive Works.

With An Inset.

This locomotive combines the four-cylinder balanced construction recently patented by Mr. S. M. Vauclain, with the Vanderbilt boiler and tender. It also has the boltless cast-steel tender truck recently brought out by Mr. Symons, superintendent of motive power of the Plant System. It happens to be the 20,000th locomotive built by the Baldwin Locomotive Works in their 70 years of continuous operation. Editorial comment on this design will be found in another column of this issue.

The driving wheels are 73 ins. in diameter, and the connecting rods couple to the forward driving axle, which has cranks between the frames for the high-pressure connecting rods. The cylinders are 15 and 25 by 26 ins., and are arranged with their axes in the same plane and parallel. Above the cylinders is a 15-in. piston valve. A glance at the cylinder drawings will show the arrangement of drainage of the cylinders and steam passages for the water of condensation. A ⅜-in. pipe drains the exhaust cavity. All four crossheads are alike and of cast steel, with bronze shoes, each weighing but 181 lbs.; the connecting rods are very short. In order to permit of an approximately perfect balancing of the reciprocating parts the pistons are made hollow, the high pressure being of cast iron and the low pressure of malleable. Type metal is run into the high-pressure pistons in order to take care of the balance, and the result, as indicated in the table, is an excess weight of but 34¾ lbs., which is not balanced. All of the revolving weights are balanced. The piston rods are of the same size and also very light. Snap rings, with Peacock joints, are applied to the pistons, the piston rods having United States metallic packing. But one set of valve motion is required, and a motion bar, offset and guided, connects with the valve stem on each side. The cranks are at right angles and the pairs at 180°, and the details of the crank axle are shown in the drawing. It is of open-hearth steel, and seems to be an excellent piece of work. It is designed for a maximum fiber stress of 18,000 lbs. In order to make room for this axle the driving wheels were "dished" and the webs brush against the boxes. The valve travel is 5 ins., the outside lap for the high-pressure valves 1 in., that of the low-pressure valves ⅞ in., and the high-pressure valve has ¼ in., and the low-pressure ⅜ in. negative inside lap. The eccentric throw is 5½ ins. With this arrangement of cylinders a low truck cradle was required, because the center bearing is brought well down by the high-pressure cylinders. Relief valves are fitted to the heads of the low pressure, and the steam passages of the high-pressure cylinders. For a starting device a plug cock is used, which provides communication through a pipe between the ends of the high-pressure cylinder, by-passing the high-pressure valve. By placing the low-pressure connecting rods on the inside journals of the crank pins the fiber stresses on these pins are materially reduced.

In arranging the counterbalancing of this engine the following actual scale weights were taken:

	High-pressure. Pounds.	Low-pressure. Pounds.
Crosshead	181	181
Main rod, front end	120	130
Main rod, back end	244	280
Pistons	343¾	368½
Piston, crosshead and main rod	644¾	679½
		644¾
Difference		34¾

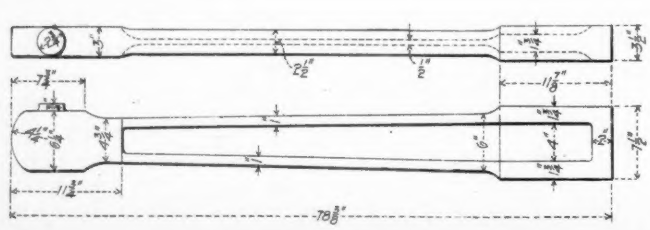
The difference might be reduced by using more type metal in the high-pressure piston, but it was not considered necessary to do so. This metal was employed because it is not expected to shrink and become loose in service.

Little need be said about the boiler and tender, as they have been described before. The firebox is 131 ins. long and 55 ins. in diameter, made by the Continental Iron Works, of Brooklyn. This provides for a grate area of 27 sq. ft., a brick bridge wall and a grate rocking in two sections. Mr. Symons's new tender truck is shown in one of the engravings. It is constructed of cast steel and put together with keys instead of bolts. There are no rivets or bolts, and the only nuts are those at the ends of the keys. This truck is believed to have a smaller number of parts than any heretofore devised. It requires some machine fitting, but the surfaces for this purpose are made small. The springs are short elliptics. An enlarged detail shows the construction of the keys and their bearings in the castings.

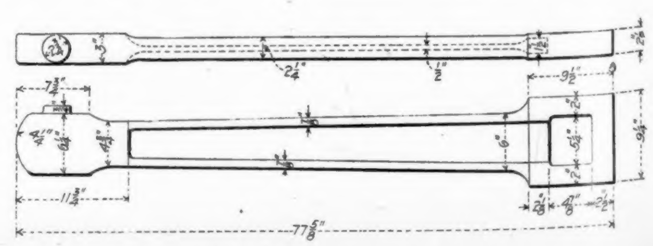
The following table presents the most important dimensions of the engine:

Four-Cylinder Balanced Compound Locomotive.
Plant System of Railways.

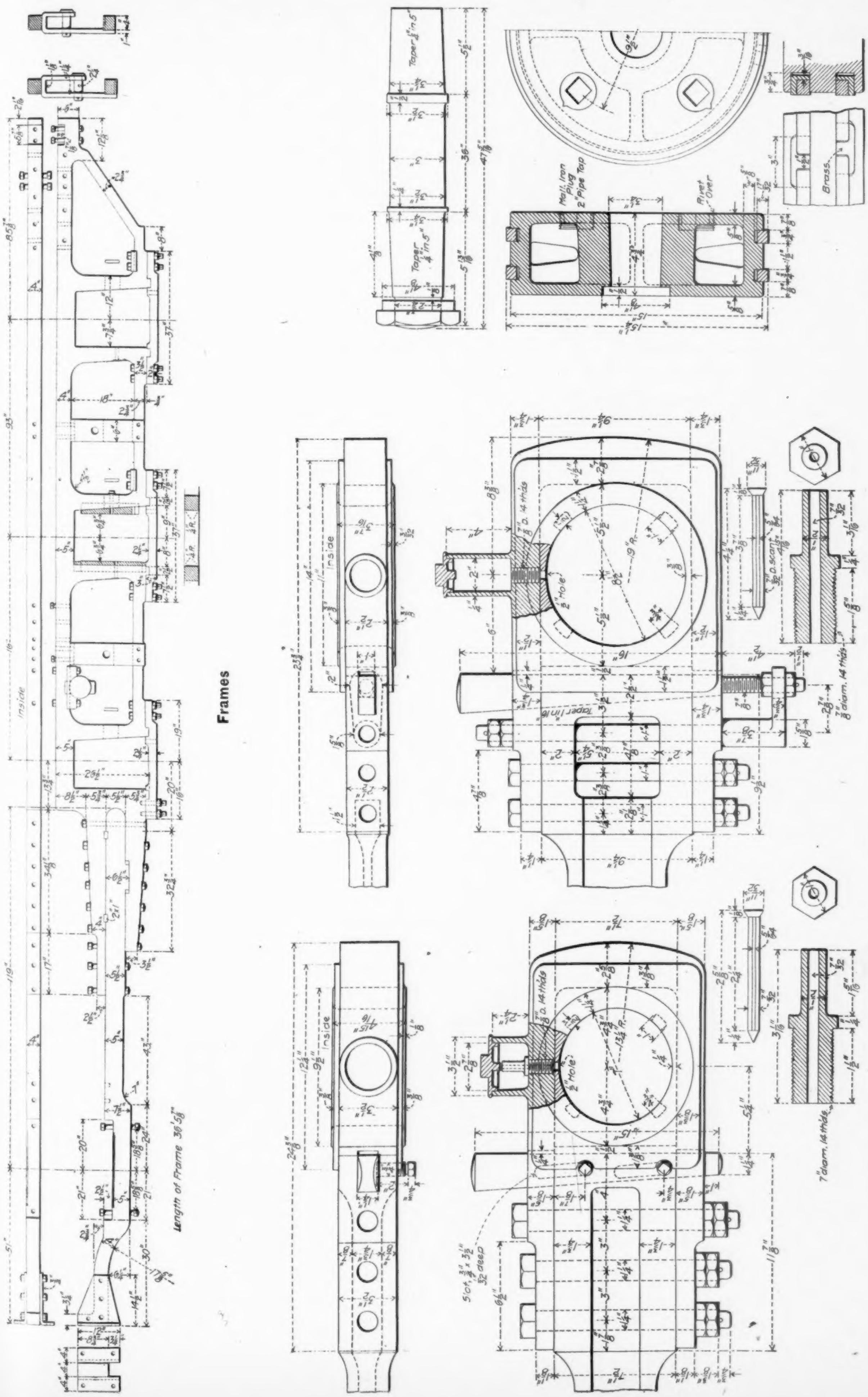
Gauge	4 ft. 8½ ins.
Fuel	Soft coal
Cylinders	15 and 25 by 26 ins.
Weight on drivers, estimated	114,000 lbs.
Weight on trucks, estimated	41,000 lbs.
Weight, total, of engine, estimated	155,000 lbs.
Wheel base, total of engine	28 ft. 4 ins.
Wheel base, driving	14 ft. 1 in.
Wheel base, engine and tender	56 ft. 0 in.
Height of stack above rail	15 ft. 6 ins.
Heating surface, firebox	128 sq. ft.
Heating surface, tubes	2,665 sq. ft.
Heating surface, total	2,793 sq. ft.
Grate area	2,725 sq. ft.
Wheels, leading truck, diameter	33 ins.
Wheels, driving, diameter	73 ins
Material of wheel centers	Cast steel
Journals, truck	5½ by 10 ins.
Journals, driving	8½ by 12 ins.
Main rods, center to center, high-pressure	83 ins.
Main rods, center to center, low-pressure	83 ins.
Valves, piston, diameter	15 ins.
Valve travel	5 ins.
Outside lap, high-pressure	1 in.
Outside lap, low-pressure	⅞ in.
Inside clearance, high-pressure	¼ in.
Inside clearance, low-pressure	⅜ in.
Lead in full gear, high-pressure	None
Lead in full gear, low-pressure	⅛ in.
Boiler	Vanderbilt
Boiler, diameter	Front, 67 ins.; back, 80⅞ ins.
Boiler, pressure	200 lbs.
Boiler, thickness	17/32 in. and 11/16 in.
Boiler seams, longitudinal	Butt, sextuple riveted, welded ends
Firebox, length	131 ins.
Firebox, diameter	59½ ins.
Tubes, number	341
Tubes, diameter	2 ins.
Tubes, length	15 ft.
Tubes, material	Steel
Stack, diameter	15 ins.
Stack, material	Cast iron
Tender, type	Vanderbilt
Tender, trucks	Symons, boltless cast steel
Tender, wheels	33 ins.
Tender, journals	5 by 9 ins.
Tank, capacity for water	5,000 gals.
Tender, capacity for coal	9 tons



Low-Pressure Main Rod.



High-Pressure Main Rod.



Frames

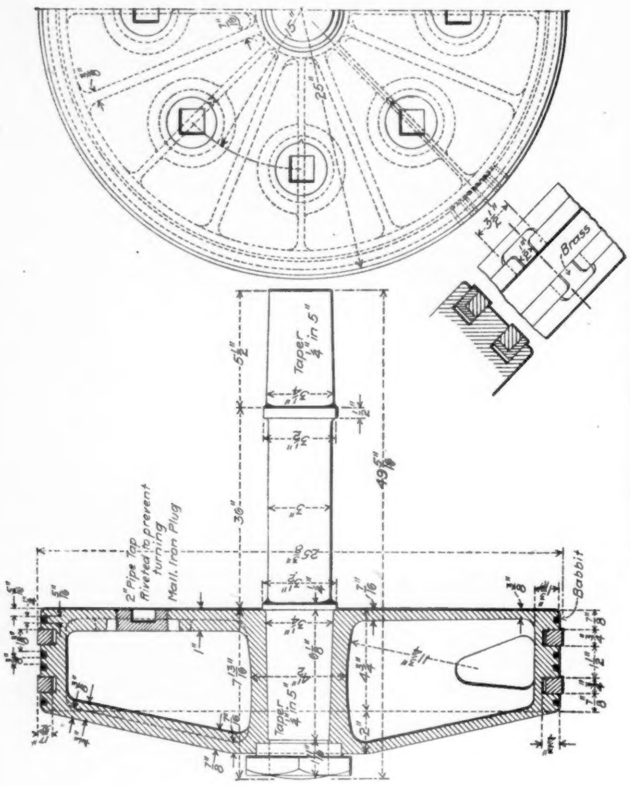
Main Rod Ends.

High-Pressure.

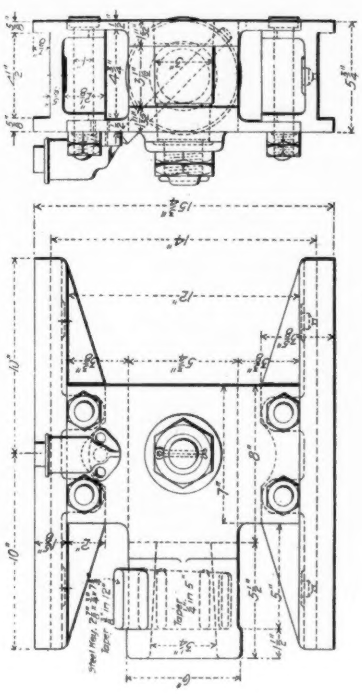
Low-Pressure.

High-Pressure Piston and Rod.

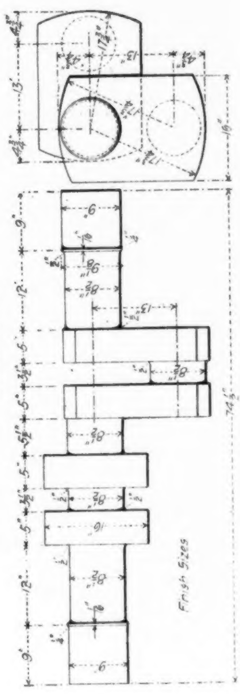
VAUCLAIN FOUR-CYLINDER BALANCED COMPOUND.—FOR THE PLANT SYSTEM OF RAILWAYS.



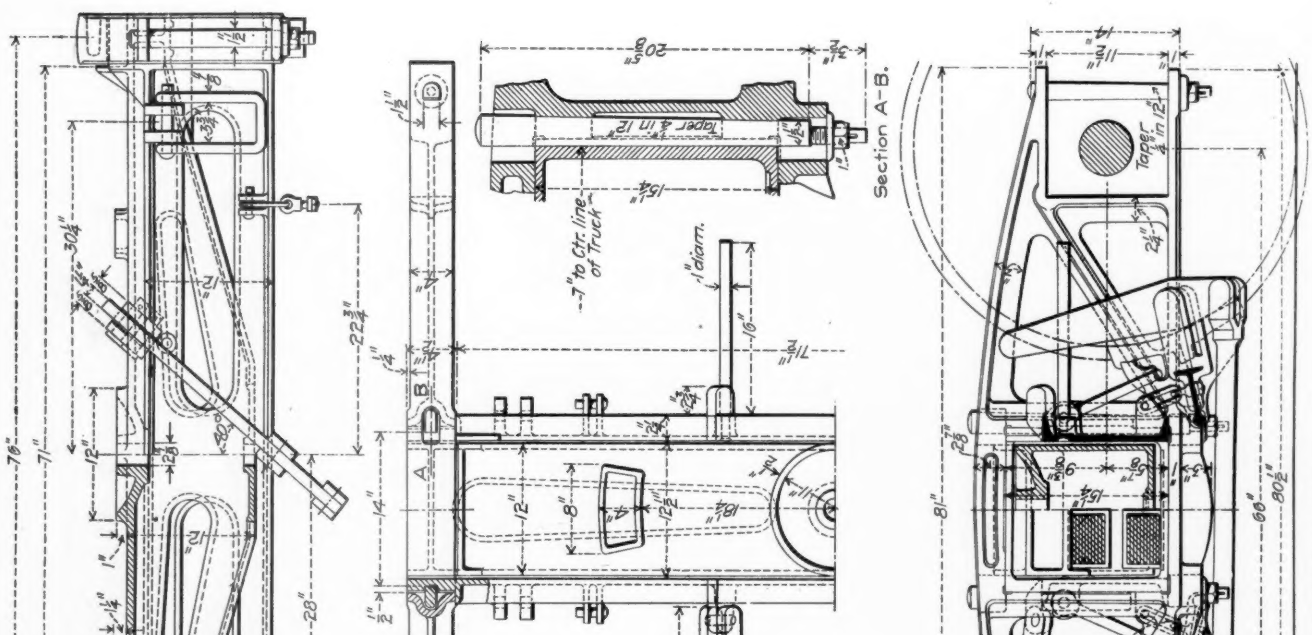
Low-Pressure Piston and Rod.



Crosshead.



Crank Axle.



Symons' Boltless Steel Truck.

VAUCLAIN FOUR-CYLINDER BALANCED COMPOUND.—PLANT SYSTEM OF RAILWAYS.

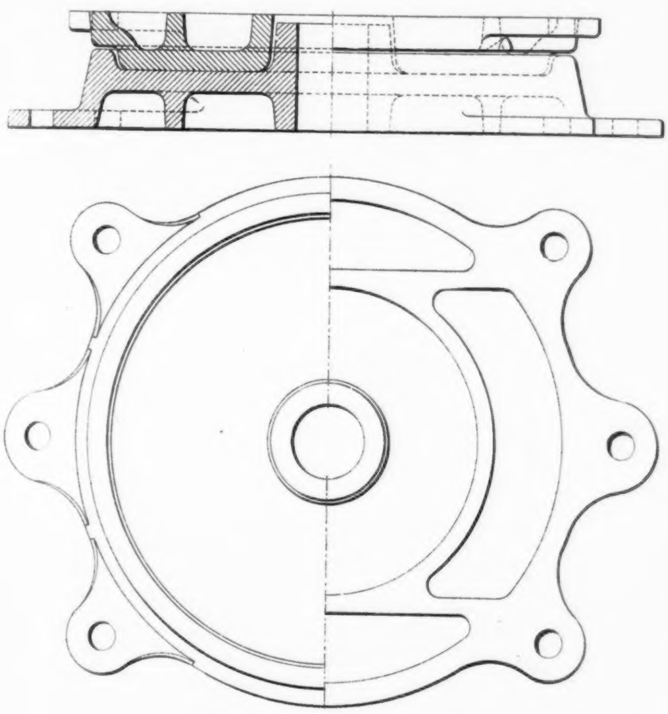
CAR CENTER PLATES.

By C. A. Seley, Mechanical Engineer, Norfolk & Western Railway.

The modern large capacity freight car requires special consideration in the design of many of its details, and the support upon the trucks, because of the greater weight transmitted has, of necessity, to be provided for in a very different structure than that which has performed satisfactory service in the smaller capacity cars.

Center plates have more to do than to merely transmit the weight of the car to the truck. The trucks of 40 and 50-ton cars weigh from 6,000 to 8,000 pounds each, and they must be pulled along by the center plates. They are generally arranged, and properly, so that the center pin does not come into play in this action. The pin should only be a safeguard, if it be even that, in case of a derailment of the trucks.

The retarding force of the brakes is applied to the trucks and in part is transmitted through the center plates to the body. There is generally some play in the plates, one upon the other, and much of the wear of the plates is due to the fore and aft play. In addition to this the movement of one plate upon the other, due to curvature of the trucks, amounts to something, although less than is generally supposed. The M. C. B. committee report on center plates in 1900 supports this. It is probable, however, if the plates are lubricated, that they will more freely respond to curvature and relieve the truck very considerably from the cornering stresses and also reduce wheel flange wear.



Center Plates of Cast Steel.

In view of the valuable information contained in the M. C. B. committee report and also in other literature on the subject, it is desired to present a few considerations with respect to a design of center plates for large capacity cars, and preferably with respect to those having metal sills or metal truck bolsters, or both.

In a design shown herewith one point to be noted is the double lock of the lower plate, the outer and inner rings both assisting in retaining the top plate in place. The outer ring is also designed to retain lubrication, and oil ways are provided whereby oil may be applied from a spout can. It will be noted, and perhaps criticized, that there is no center pin bearing in the top plate. This is purposely omitted. The inner ring of the lower plate extends up some distance, enough to retain the top plate under a considerable separation of the plates, due to a derailment. If the top plate goes high enough to get away from the outer ring it may mount upon the inner ring of the lower plate and bear against the center pin, which would then be in simple shear.

With center plates having but a shallow lock and a center pin bearing in both plates, the pin is quite sure to bend between the bearings in case of a derailment. In the present design, if the top plate goes higher than the top of the inner ring the pin may bend, but we have provided for ordinary contingencies, and center pins are of little value in controlling a derailed truck of a large modern car.

The bottom view of the bottom plate is shown in order to explain the ribbing under the bearing surface, which is similar in both plates. The straight ribs are intended to coincide with the webs of the truck bolster members and with the webs of the body center sills, or as near thereto as will give a maximum of support to the bases of the plates by interposing continuity of bearing between the car and truck. There are also semicircular ribs supporting the bearing surfaces about midway, and cross ribs may be introduced if thought necessary.

A study of the cross-sections leads one to believe that these forms will mold readily; that the section is uniform and so arranged as to produce straight castings; that the plates are about equally strong to resist deformation; the fastening lugs are so separated as not to influence an unequal shrinkage and consequent warping. The bearing area is ample, and considerable wear is allowed for before the center ring would have a bearing on the body bolster. They could be made in either cast steel or malleable iron, the former being preferable for very large capacity cars. To be fair to the reader, be it said that this is a proposed design, and not one actually in service at the time of writing.

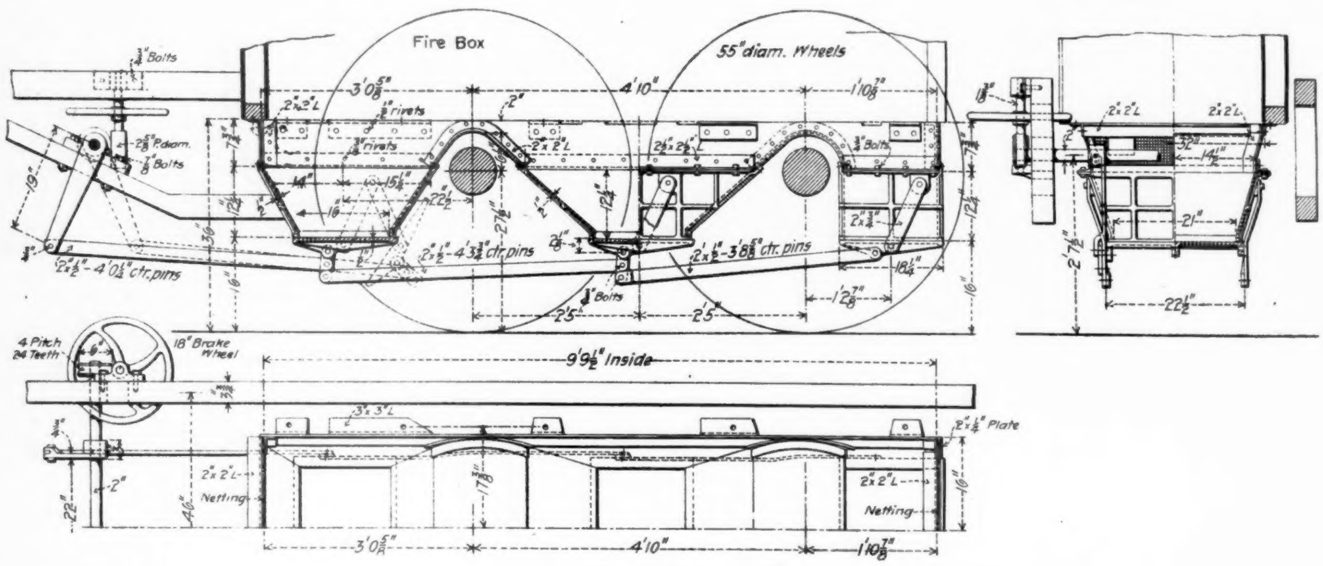
THE BOLSTER PROBLEM.

The bolster problem will probably ultimately be solved as an incident in the settlement of the more pressing draft gear question. Mr. R. P. Lamont's paper, read recently before the Western Railway Club, is summed up in his conclusion: Provide a reasonable space for the bolsters, also a reasonable proportion between length and depth and pay for enough metal, so that the stresses can be kept within safe limits. To provide this vertical space of 10 or more inches for the body bolster of flat-bottom cars simply involves the use of a low truck and a low truck bolster. There has been, however, a decided aversion to changing car construction for the benefit of the bolsters. A weak bolster settles down on the side bearings and so attracts little or no attention, while failures which put a car out of service demand consideration. Weak draft gear means a failure which cannot be ignored, as the weak bolster may be. Draft gear is, therefore, likely to be improved. Underhung draft gear of 20,000 to 40,000 lbs. capacity will transmit comparatively light shocks on the line of the sills by the coupler horn striking the end sill, but the fallacy of attaching high capacity draw gear beneath the sills has already been demonstrated in service, on a large scale. Experience has shown that draw gear should be placed on the neutral axis and between metal center sills. This does not necessarily mean an entire steel underframe, but this is doubtless the logical result. This location of draw gear means cutting or piercing the end sill, and that of necessity points to steel end sills. It seems hardly worth while to use steel center and end sills, and then make the remainder of the frame out of wood. The steel underframe would, therefore, seem to be the final form of car construction which will be used, and when used the bolster problem will be solved.

ASH PAN CONSTRUCTION FOR LOCOMOTIVES.

Great Northern Railway.

By the courtesy of Mr. Max Toltz, Mechanical Engineer of the Great Northern Railway, a drawing has been received illustrating an ash pan arrangement for which he has applied for a patent. The hoppers are of cast iron, bolted by means of angles to the upper section, which is also secured by angles to the mud ring. By means of swinging links pivoted at the sides of the three hoppers the flat cast-iron valves are supported so that they may be swung to the right, as seen in the engraving, to clear the openings, and when replaced they are brought up against their seats and held firmly so as to make tight joints with the hoppers. A small obstruction on one of the plates does not prevent the others from closing, because of the equalized connections. One of the valves is shown in its open position by dotted lines. In this case the valves are operated by a wheel, placed under the frames. This wheel turns a worm, as indicated in the drawing, and it is necessary for the fireman to be upon the ground when dumping the ashes, but the wheel may be placed in the cab if desired. In this construction the air admission is at the front and rear of the ash pan, through openings covered by wire netting. Much more attention is given to ash pans than was formerly thought necessary. They should be designed with a view of facilitating the cleaning of engines, and in order to avoid burning and warping the castings the joints should be tight enough to exclude air from the hot coals among the ashes.



Ash Pan Construction for Locomotives—Great Northern Railway.

WEAR OF JOURNALS.

The most economical axles are those under tenders, is the opinion of Mr. David Van Alstine, superintendent of motive power of the Chicago & Great Western. He explained, at a recent meeting of the Northwest Railway Club, from investigations he had made that the average life of tender axles for ½-in. wear in diameter was about 14 years, or perhaps 490,000 miles, and only 5 per cent. of these axles had been removed for worn collars. The large mileage they had made was probably due to the excellent care they received, and the average light loads they carried. With regard to engine truck axles the records were very incomplete, but they indicated that for ½-in. wear the average life appeared to be 7 years, or say 245,000 miles. This low average is accounted for by the use of babbitt bearings, and having usually smaller wheels they make more revolutions per mile and run at higher speed than the tender axles. The record of driving axles shows an average of 476,800 miles; this corresponds to about 13 years' service for ½-in. wear.

Driving axles have a tendency to wear taper and hollow. This uneven wear is, no doubt, due to an uneven distribution of dirt in the packing. Uneven wear, which concentrates the load on small areas, sufficient to exclude the oil, produces a hot box. A driving box which will distribute dirt uniformly along the journal, or better, exclude it altogether, is much to be desired.

Freight-car axles (4¼ x 8 ins.), show a life of 3.83 years for every 1/32-in. depth of wear, which brings them to about 30 years for ½-in. wear, which is the full life of the axle. Assuming that a freight car makes 25 miles per day, the life of the axle would be about 274,000 miles. This is not much more than half the mileage of passenger-car axles. The probable explanation is that freight axle boxes contain more dirt, and so wear the journals away quicker. The average for passenger-car axles of 4¼ x 8 ins. points to a life of 7 years, which probably equals 504,000 miles for ½-in. wear.

The conclusion which Mr. Van Alstine draws, is that the quality of the bearing metal and the packing need not be a source of much anxiety. The increase in the life of journals, and a decrease in the number of hot boxes, depend mainly on the exclusion of dirt.

In a recent discussion of the subject of repairs to all-steel cars, a committee of the Central Railway Club laid special stress on the protection of the metal by frequent painting. These cars should be painted inside and out at least once in eighteen months. It was found to take longer to clean the surfaces than to paint them, and the sand blast was recommended for this purpose. One speaker referred to the successful use of small pneumatic hammers with broad-faced flat chisels for cleaning the metallic surfaces of government vessels before painting. For steel car work the spray method of painting was recommended because it was of low cost, and also because the jet would reach points where were inaccessible to the brush. To reduce the cost of repairs and the present long delays to steel cars in the shop, proper special tools should be provided.

BRAKING POWER OF 100,000-LB. CARS.

The modern relation of revenue load to tare weight has introduced a new problem in brake service. Formerly, when cars weighed a considerable proportion of the gross weight hauled, the difference between the braking power of light and loaded cars was not so apparent. Nowadays, with heavily loaded cars of comparatively light individual weight, the brake problem has taken definite shape. Mr. H. H. Forney, general air-brake instructor of the Southern Pacific, speaking at a recent meeting of the Pacific Coast Railway Club, said: These cars must have sufficient braking power to be handled safely in any kind of service; the power must be sufficient to permit of their being handled safely on the ruling grade; the arrangement or adjustment of the braking power must be simple and strong, and must conform in a general way to the standard apparatus now in use; and this arrangement must not be a radical departure from standard practice.

Owing to the great difference between light and loaded cars, it will be necessary to have some form of brake equipment which will admit of exerting more power on a loaded car than on an empty one, and the braking percentage on a loaded car must be high enough to insure its holding itself. As Western mountain grades are not usually more than 2 per cent., the speaker thought that 30 per cent. of total load might be accepted as the minimum allowable braking power. The present maximum is 90 per cent. of the light weight. With the comparatively light weight of modern large capacity cars, the 30 per cent. minimum limit cannot be obtained. Large capacity cars are to-day being operated with a total braking percentage of from 17 to 21, and this means that other cars with excess braking power hold them.

Mr. Forney suggested, therefore, the application of a foundation rigging strong enough to withstand twice the strain now permissible, and also to equip these cars with two brake cylinders, so arranged that one cylinder would operate on an empty car at 75 per cent. of its light weight, and when loaded both cylinders would operate, thus giving 150 per cent. of light weight, but which would actually be about 35 per cent. of the total load. Each car in a train would then be an effective braking unit, able to hold itself without help from others.

TAR BURNERS AS AN AUXILIARY TO COAL ON LOCOMOTIVES.

Oil, or tar, is used as an auxiliary to coal fuel on express locomotives for the Eastern Railway of France. According to "Engineering" the boiler is of the Belpaire type, with ribbed Serve tubes; the firebox is fitted with a brick arch and with two tar burners. The engine is fitted with four steam cylinders, and is provided with a starting device for the direct admission of steam to the low-pressure cylinders. The two tar burners are placed on each side of the firebox door, and do not interfere with the ordinary working with coal; they are not intended to replace coal firing, but to increase when necessary the heat developed and the power of the locomotive on the steeper gradients. The burners are of the Vétillard and Scherding type; the tar is contained in a receiver on the tender, whence it is brought down to the ejector, a tap regulating the flow. The tar is supplied to the firebox by a steam jet. When necessary, live steam is delivered inside a serpentine pipe placed in the receiver to heat the tar and give it the required fluidity. Each ejector allows the burning of 220 lbs. of tar per hour under good conditions. The tar receiver is made to hold one ton of this special fuel.

WATER STATIONS.

The committee appointed to report to the Association of Railway Superintendents of Bridges and Buildings on water stations, upon the best material for foundations, tanks, substructures, connections, capacity, etc., presented a very interesting report. The committee sent out circular letters, in which twenty questions were asked. The reply from the Erie Railroad stated, among other things, that the height of the bottom of the tank above the rail, for that road, was 30 ft. In the matter of cost, the total was $2,704.26, of which $832.43 was the cost of a steel trestle, weighing about 30,270 lbs. A pine tub of 50,000 gals. capacity costs $275. In looking over the figures for the foundation, the most costly item is for Portland cement, which amounts to $63. Exclusive of labor the foundation appears to have cost $177.04. Masons' labor was $239.12, and carpenters' labor $186.91. The principal items in the plumbers' bill were, a 10-in. Mansfield standpipe, complete, $225; 10¾ tons of cast-iron pipe, $236.50, and plumbers' labor, $153.23. In the report from the Boston & Maine Railroad a 16 x 24-ft. water-tank foundation is quoted as costing $350. The tank, complete on the foundation, including fixtures for delivering water to engines, amounts to $1,200. The standard height on this road from bottom of tank to top of rail is 13 ft. 6 ins., but this is to be increased, probably to 14 ft. 6 ins.

ELECTRICITY AT THE NEW YORK NAVY YARD.

In rebuilding the machine shops of the New York Navy Yard, after the fire of 1899, the question of electric driving came up, and was finally decided by the introduction of the alternating current system. This system possesses advantages for transmission over considerable distances, transformers being used at the points of application. The new buildings include a machine shop 350 x 130 ft., an erecting shop 252 x 130 ft., and a boiler shop 300 x 96 ft., all being fireproof and equipped with modern tools. The generating plant consists of three sets with McIntosh-Seymour engines and Westinghouse alternators. The engines at 136 revolutions give 630 horse-power. The alternators have 25 periods per second, two-phase, at 220 volts pressure. The generators have a guaranteed efficiency of 94½ per cent. at full load, and 84 per cent. at quarter load. The motors range from 200 horse-power to 30 horse-power. The entire plant is designed in accordance with most advanced ideas. Standard apparatus is used throughout, making duplications or possible renewals very easy. The equipment of this plant in thoroughly modern style removes from the Government the reproach often merited, of being too conservative. Its good example in this case will be felt.

RICHMOND RAILROAD CLUB ORGANIZED.

A meeting was held on January 18, in Richmond, Va., which was largely attended by prominent railroad men of the city and state. The motive of this gathering was to organize the Richmond Railroad Club. The object of the club is similar to that of the existing railroad clubs, of which there are now twelve. Mr. W. S. Morris, Superintendent of Motive Power of the Chesapeake & Ohio Railway, was chosen president of the new club. Mr. C. S. Churchill was elected first vice-president; Mr. R. C. P. Sanderson, second vice-president, and Mr R. E. Smith, third vice-president. Mr. F. O. Robinson was elected secretary, and Mr. W. F. La Bonta accepted the treasurership.

One of the scholarships of the Master Mechanics' Association at Stevens Institute of Technology will be vacant in June, 1902, upon the graduation of one of the students. The scholarship confers the privilege of attending the entire course of four years at the Institute free of all tuition charges. It is open to sons of members or deceased members of the association, and particulars may be obtained from Mr. J. W. Taylor, secretary, 667 Rookery Building, Chicago.

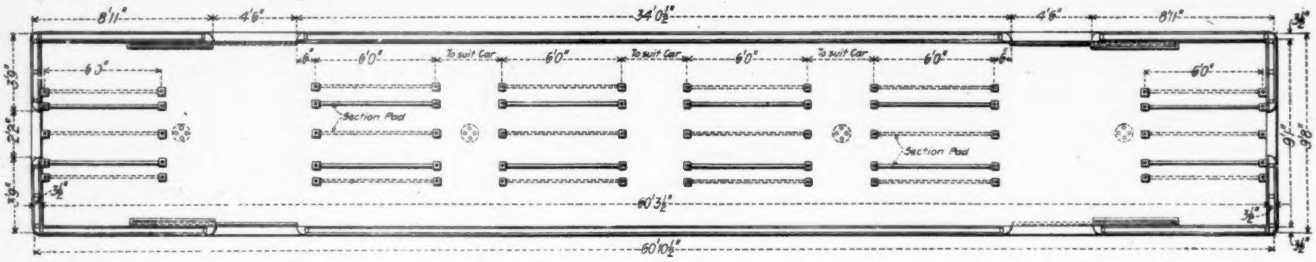
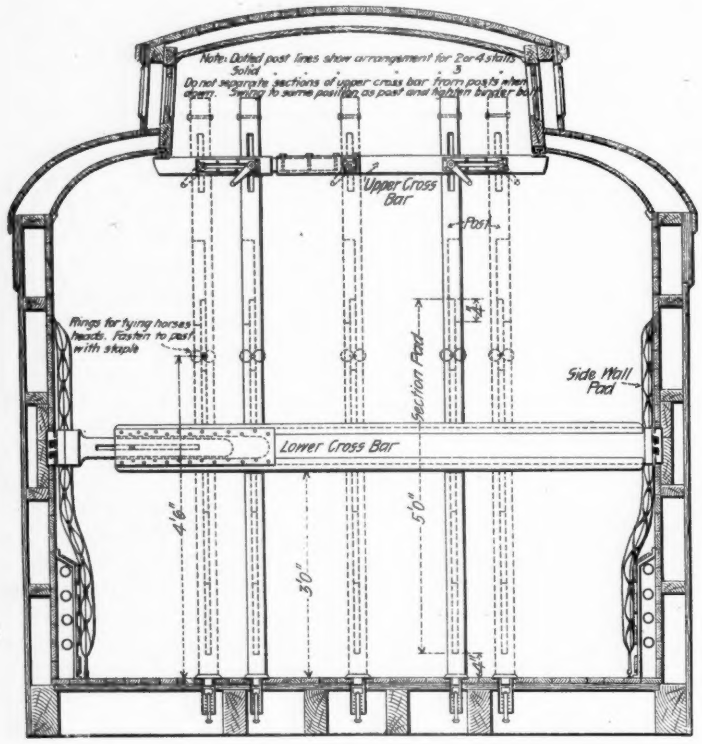


Fig. 1.



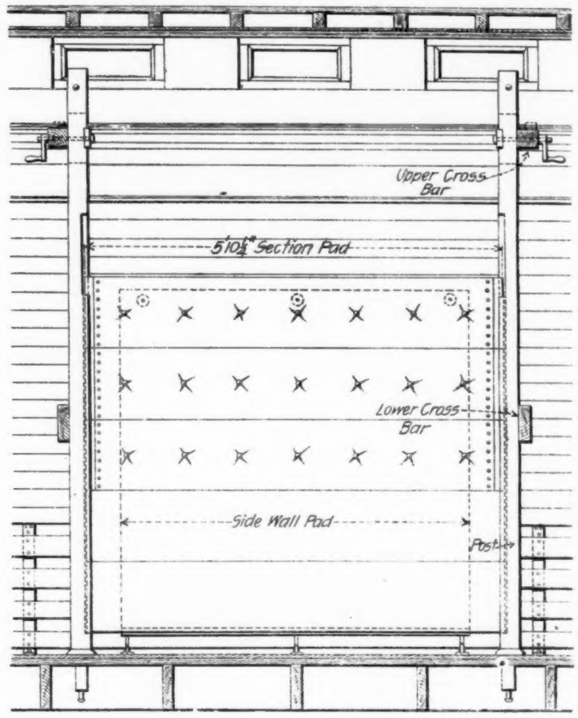


Fig. 2. Fig. 3.

Improved Equipment for Horses in Baggage Cars.
New York, New Haven & Hartford Railroad.

Fig. 4.
End View of One of the New Cars.

IMPROVED EQUIPMENT FOR HORSES IN BAGGAGE CARS.

New York, New Haven & Hartford Railroad.

These drawings and photographs, illustrating the latest practice of the New York, New Haven & Hartford in the transportation of horses, have been received from Mr. W. P. Appleyard, Master Car Builder of that road. They show the construction and application of a portable horse stall to baggage cars, the device being patented by Mr. J. P. Young, General Foreman of the car department.

This improvement seems to offer advantages over previous arrangements for this purpose. It furnishes means for the safe and comfortable transportation of horses without requiring the maintenance of distinct lines of car equipment for the purpose. The stalls may be applied to any class of baggage or express car used in passenger service, or they may also be put up in any style of box car. Once fitted to receive the stalls, a superior horse car is available, and the removal of the posts and stall divisions leaves the car perfectly free of all obstructions, and it is immediately available for its regular service. There is no nailing up of timbers of any character; the stalls may be applied or removed by two laborers in 15 minutes, and no tools are required. As the best

of material is used, the stall equipment should last as long as the car. This stall has been adopted by the New York, New Haven & Hartford; the Erie; the Atchison, Topeka & Santa Fe, and the Southern Pacific Railways, and also by the Adams and the Wells-Fargo express companies.

In the illustrations, Fig. 1 is a plan showing the stalls arranged for four or three horses, across the width of the car, the solid lines indicating the arrangement for three horses. Fig. 2 is a cross-section showing the ends of the stalls and the breast boards. This view and Fig. 3 illustrate the details of the attachment whereby the use of tools is avoided. In the photograph, Fig. 4, the end of the car, with the wide door, is illustrated. The plank is made in sections, and is carried in slings under the car when not in use. The portable parts of the stall equipments are kept at different points on the line, thus permitting a car to be fitted up at short notice to give accommodation for 24 horses in a 60-ft. car, with sufficient additional room for attendants. The wide end door is used to accommodate carriages.

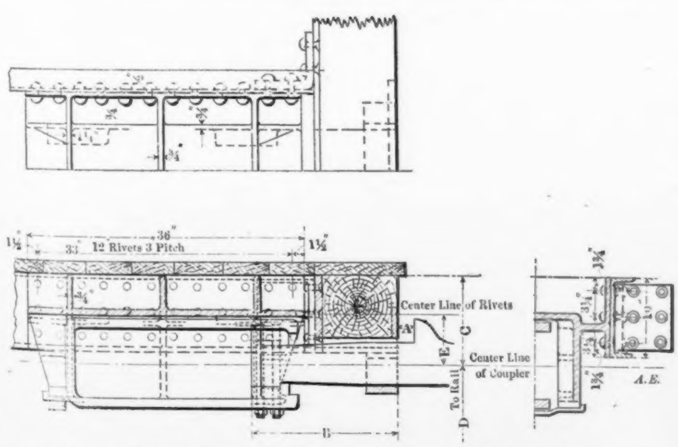
Other descriptions of horse-car equipment for using baggage or express cars, may be found in the American Engineer of the following dates: June, 1898, page 193; February, 1899, page 47, and October, 1900, page 310.

A NEW TENDER DRAFT CASTING FOR FRICTION DRAFT GEAR.

By Frank B. Kleinhans.

When the Westinghouse friction draft gear was placed on the market, a short time ago, it was thought that cast iron would be satisfactory for the draw castings, but since some of these have broken with only a few months' service, cast steel has in some cases been substituted. There is little, if any, difference in cost, for while cast steel is more expensive than cast iron, the design can be made lighter in steel, and this will about offset the increased cost.

The usual arrangement of these castings is to butt them against the bumper, and then having a flange to extend under



A Cast Steel Draft Casting for Locomotive Tenders.

the channels; bolts are placed through the flanges. In the first place, there is no reason for butting the casting against a bumper on one side and having nothing on the other, since the thrust on the draw bar is as great in one direction as in the other. And, secondly, a new pattern must be made for every variation in the thickness of the bumper, and for every change in the height of the coupler, and everyone knows that holes should not be drilled in the flanges of the channels, for they are over-hanging beams to support the load of the tender, and to take up the thrust of the draw bar.

In this design it is proposed to do away with three things: Butting the casting against the bumper, drilling holes in the flanges, and making new patterns. In order to do this the entire impact on the draw bar will be taken up by rivets, in the same way as the columns in the steel structural work are supported by rivets in the foundation plates.

In deciding upon the length of the casting to be used two things must be looked out for. In the first place a good substantial base must be provided, and, secondly, the casting must not interfere with the truck. Thirty-six inches gives a substantial base, and will very rarely interfere with the truck. By keeping the rivets 1½ inches from the edges, we have 33 inches over which to distribute the rivets. The sizes of the channels would be determined by the weight and capacity of the tender. A 10-inch channel of 30 lbs. per foot, ½-inch web and 8½-inch area would represent the average section, and for this section ¾-in. rivets would be used. Now as to the force acting on these rivets. It is known that a wrought-iron section equal to 12 inches will outlast any of the couplers on the market. Taking the working stress at 10,000 pounds per sq. in. we could have a draw bar impact of 12 × 10,000 or 120,000 pounds. This force acts in the line of the center of the draw bar. For direct tension, taking the shearing stress of the rivets at 10,000 pounds per sq. in., we would require

$$\frac{120{,}000}{10{,}000 \times .44} = 27 \text{ (rivets).}$$

For eccentric loading, a sufficient number of rivets must be uniformly distributed over the 33 inches to be equal in strength to a key 33 inches long, and of sufficient width to carry the load. Referring to the engraving, the distance E from the center of gravity of the rivets to the center of the draw bar, is the arm of the eccentric load. We may take this at 8 inches, and, with the following notations,

W = draw-bar impact = 120,000 lbs., L = arm of the eccentric load = 8 ins., M = bending movement, Z = movement of resistance, S = the shearing stress on the rivets, b = breadth of the key, h = length of the key;

we have,

$$M = W \times L = SZ,$$

$$Z = \frac{WL}{S} = \frac{bh^2}{6},$$

$$b = \frac{Z \times 6}{h^2} = \frac{WL \times 6}{S \times h^2},$$

$$= \frac{120{,}000 \times 8 \times 6}{10{,}000 \times 1{,}089} = .52 \text{ inches.}$$

The number of ¾-in. rivets to be equal in strength to the key will be

$$\frac{.52 \times 33}{.44} = 39.$$

The total number of rivets required to withstand the load will be 27 + 39, or 66, but to be on the safe side, and to give a good spacing of the rivets, 32 have been placed on each side. There will also be a thrust, due to the eccentric load on the draw bar, which will tend to push the end of the channels vertically up or down, and this action will be about the center of the support of the beams. We may take the truck 4 feet from the rear end, the thrust will then be

$$\frac{120{,}000 \times 8}{48} = 20{,}000 \text{ pounds.}$$

This will easily be taken up by the corner plates, as shown. These plates will also help to stiffen the frame.

The two faces of the casting in contact with the channels will be faced off, and holes drilled 1/16-in. small. A sheet-iron template can then be made, and holes scribed off on the web of the channels. The holes can then be punched or drilled. The casting will then be held in place with a few bolts, holes reamed to size, and then riveted together. It will be seen that the pattern can easily be altered for various distances at C and D. The center can be raised or lowered and ribs altered to suit, the core box in any case remaining the same. A and B are fixed distances, hence for any variations in the bumpers the casting can be shifted to suit.

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EDITORIAL ANNOUNCEMENTS.

Advertisements.—*Nothing will be inserted in this journal for pay,* EXCEPT IN THE ADVERTISING PAGES. *The reading pages will contain only such matter as we consider of interest to our readers.*

Contributions.—*Articles relating to railway rolling stock construction and management and kindred topics, by those who are practically acquainted with these subjects, are specially desired. Also early notices of official changes, and additions of new equipment for the road or the shop, by purchase or construction.*

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The next vacancy in the two scholarships of the Master Mechanics' Association will occur next June upon the graduation of one of the students now enjoying this privilege. We take pleasure in mentioning this fact prominently. Mr. J. W. Taylor, secretary of the association, will furnish particulars with reference to eligibility of candidates.

At least three vitally important subjects in car construction are to come before the Master Car Builders' convention next summer. These are the standard box car, improved draft gear and side bearings and center plates. The third of these is perhaps the least in the minds of most of the members. It is not a mere matter of detail construction of the castings used for side bearings and center plates. If so it would be sufficient to design good castings. The real question involves the construction of trucks, bolsters and car underframes. The expected report offers an opportunity for settling several mooted questions, which involve large expenditures of money, and it is time that these should be definitely disposed of. The present situation as to side bearings and center plates is anything but satisfactory.

Within a short period four prominent motive power officers have been selected for important operating responsibilities, and the fact seems significant of changing conditions of railroad methods. For many years train service experience has been considered as the best preparation for the high administrative positions, and this has brought out many able men. Train service, civil engineering and other departments are not less important than formerly, but the present course of the greatest development is in the direction of motive power. At least here is where the greatest possibilities lie, and he who best understands the locomotive and its use is best able to make the maximum contribution to future improvement. Those methods which bring the best development of the locomotive and its operation are to be recognized and rewarded in the future, for purely business reasons. Methods of selecting motive power men must change, also their treatment and, what is more, something must be done to attract the necessary ability to this work. Wall Street will soon discover these facts and will learn that the day of the motive power officer who is merely a good mechanic is past, and that brains and business ability are required. Furthermore, it will become clear that mechanical men are very much like other men and are likely to go where they are appreciated. In fact, they are doing so.

Messrs. Delano, Potter, Morse and Marshall are able men who deserved advancement, but there is much more to be seen in these appointments than the mere recognition of ability. They are given higher positions because they fill them better than other men who were available. They have been successful mechanical officers and have shown their ability to organize and direct large departments in which the responsibilities are great and varied and where it is impossible to follow precedent or rule. The mechanical chief needs to be an organizer, a mechanical engineer, a manufacturer, a business man, a controller of labor and a thorough railroad man. For any individual one of these attributes men receive good compensation, but when they are all combined in a mechanical officer he is not properly recognized or paid.

If these appointments mean that superintendents of motive power may become recognized and properly compensated railroad officers, and that the owners of railroads are beginning to learn that this is good business policy, we are at the opening of a new dispensation which will prepare the way for great possibilities for the future. We are firm in the belief that the locomotive and its operation has only begun its development. It cannot develop until the shackles and manacles of opinion in which its department is held are removed, and they seem to be loosening.

A PROMISING LOCOMOTIVE.

In this issue the new passenger locomotive for the Plant System is described. This engine is the first to appear in this country under the responsibility of a railroad for a trial of the four-cylinder balanced-compound principle, which has been so successful abroad as to fairly represent the direction of locomotive development there. If the judgment of this journal is correct this design is the most important now before American railroad men. If the expectations of its sponsors are realized it will show that through the division of the work among four cylinders with separate connections and the balancing of the reciprocating weights, means are available for an increase of capacity which will move the approach of the limit of locomotive power far into the future. The foundation for these expectations has been repeatedly presented in these columns.

There seems to be but one drawback to this design—the crank axle. A great deal, therefore, depends upon the behavior of this important member. This axle was made of the best-known material by the manufacturers of the crank shafts of many of our fine war vessels, and it was made without specifications, entirely upon the honor of the makers to furnish the best that their experience and skill can produce. Aside from the crank axle the engine has no untried and unknown element, and our foreign readers, especially in France and on the Continent, will probably smile at our caution in this particular. Crank axles have a bad name here, but it should be remembered that the growth of the locomotive and the increased severity of its service since the days of the old,

inside-connected engine have been accompanied by improvements in steel and its working. If this axle meets the requirements this engine seems sure to be the beginning of a new dispensation, the importance of which is not likely to be overestimated.

The eccentrics are on the second axle and a long connection to the valves is required. The engine has a relatively small grate area, and very short connecting rods. For a trial of the principle as a test of all there is in it these conditions might perhaps be improved upon, but these features are not believed to be, under the circumstances, vital in a trial of the running gear, which is the real feature at issue. Those who examine the details will not fail to be impressed in these days of huge and heavy parts with the remarkably light reciprocating parts and connections, and this is one of the reasons why this type of engine seems especially worthy of attention now. Crossheads weighing 181 lbs., and connecting rods weighing 364 lbs., seem almost like toys in comparison with usual present practice. It is true that the number of these parts is doubled, but it seems perfectly reasonable to divide the stresses when they become as large as they are to-day. It is but little less than brutal to place a direct stress of 99,000 lbs. on a single crank pin, as is done on certain large engines to-day.

As to balancing, it is interesting to know that the reciprocating weights may be provided for within 34¾ lbs. In contrast with this, on recent large freight engines there is not room enough in the main wheel for the weights which should be put into them. The smooth riding of a balanced engine, while important, is secondary to the gain in the increased weight which may be placed on driving wheels by this system.

It will be worth while to watch for the reports of experience from this engine.

THEORY OF COMPENSATION OF LABOR.

A significant sign of the times most clearly indicated in the ascendancy of American manufacturing is the general tendency, for business reasons, toward improvement in methods of paying for labor. The payment for labor actually performed, instead of paying for time occupied, is piece-work, though it goes by different names. Piece-work is not new, and little that is new remains to be said about it; but conditions have now been reached which never before existed, and piece-work now appears to be the point of the wedge which is opening railroad mechanical work to the adoption of business or manufacturing principles. Under this system railroad shops may be placed on the plane of the successful manufacturing establishments which have sent American locomotives and bridges all over the world. The system has been ready for a number of years, and now it appears that the railroads are ready for the system. At least some of them are, and it is important that the principles should be understood, because many blunders have been made, and there are doubtless more to come. In spite of mistakes, however, the movement is gathering momentum, which is sure to carry it on.

The principle involved is that of co-operation, every man becoming a contractor, in business for himself, and not placed in a class which does not provide proper distinction and recognition between different grades of ability. It is well known that the men resist it, but who would not under the conditions which have prevailed? In too many cases employers have put it into effect by bulletin notices. They have tried to create it at one stroke, and to show that this is not the way to succeed is the object of this discussion and of others to follow it. This movement must come by evolution, not revolution, or it will always fail. It must be introduced on a basis of confidence and continued on a basis of honesty. Everything must be open and frank in the dealings, and the men should have access to all the information they require to fully understand their situation.

Piecework and the development of home talent together seem to be the sum of the industrial problem. Piecework should be a part, and not the whole scheme of management. As to scope and possibilities, there seems to be no limit except in the ability of the officers in its administration.

"Preparedness is the secret of most successes in this world. Fate seldom makes league with the unequipped. Events come marching into every century, into every day, crying aloud for the nation or the man who is prepared."

This was never so true of anything as of this subject, and those who have not studied it for at least several years should not undertake to introduce it. A necessary part of the preparation begins with the management. The higher officers must be ready to see the men make large wages, and unless the management is stable, and the policy steady, it should be let alone. There is no place for quick record making in connection with piecework, and the time has come when he who attempts to meddle with piecework and cut prices by wholesale becomes responsible for results which will some time make him shudder. A newly appointed officer, imported from another road, should never attempt piecework, and when he really knows his men he should make but one move in about six months. That is to say, he should move carefully and slowly. The confidence of the workingmen of to-day is given only once, and it is too important to be trifled with. This confidence is the basis and foundation of success in the management of men, and the lack of it explains the deplorable industrial struggles of the past.

Piecework schedules of other roads are frequently asked for by those who are introducing the system. Until after one's own schedule is prepared, the knowledge of what others have done is useless, and even dangerous. Price fixing by copying the schedules of others will never do, because on most roads the prices among the different shops must vary, and so also will they vary on different machines in the same shop. Local conditions should fix the prices. A very careful study of these conditions should be made, and the men should be fully informed of what is being done, and they should be encouraged to study the problem with you. They should be given to understand in no uncertain way that your motto is absolute fairness; that both you and they will make mistakes, and that both must be always ready to correct them. A volume could be written on this subject alone.

A prominent lawyer once said that if he was pleading a jury case and should prepare an address to the jury in advance of hearing his opponent's case, he was sure to lose; but if he first heard all the other side had to say, and then addressed the jury in view of all of the facts, his case was usually won. Begin piecework by a lot of talking and a thorough acquaintance with the men. Get the leaders and the foremen interested. Then start it so that the men will ask for its extension. Never try it with a promise to give it up after a stated time if the men vote against it. Find a man who is in sympathy with the principle and has a standing with the men in experience, knowledge and integrity. Let him study conditions and take charge of the problem, but never try to say: "Go to! We will now have piecework!"

For successful administration on a large railroad system with many shops a competent general piecework expert is a necessity, and he, being one man out of a million, is difficult to find. This is the field, if there ever was one, for a specialist. He must be a man who can overcome prejudice, stir the manhood and inspire the honest purposes of the men. He must be prepared to meet them at every point, as one having experience and knowledge of their capabilities, as well as those of the machines. He must have sufficient authority and ample support, for his work is difficult and its scope is broad, covering every feature of shop practice, including the equipment itself. This man must have such command of the situation as to enable him to change rates which

are wrong, and to do this with the consent of the men, by putting them on their honor. It has been found that the men will themselves sometimes suggest lowering prices which are too high, and this is the severest test of the administration of the system.

Careful records must be made of what each tool can do under given conditions, and what men can do, as a basis for payments. The prices must not be based upon less than the full capacity of the machines, and they must not be fixed for the expert man who can double the ordinary output. The price fixing requires study, experience, and the hearty co-operation of the men who do the work. It must be based on a good day-work system to start with.

Another chapter would be required to state the results of piecework. It may be summed up in increased output, decreased cost, contented men, new and better methods every day because of the use of the brains of the men. The men earn larger wages, and this tends to steadiness. They have no desire to leave the service. They buy houses and become factors in the community and become better citizens. In a piecework shop, properly managed, there are no "floaters," and changes come rarely, except when men die. By placing the responsibility, and requiring poor work to be replaced, the quality is improved by this system. With the actual cost of work as a basis, a valuable check on designs is available; and when it is shown that unnecessary "finish" on a certain piece costs 25 cents, the finish is left out. Piecework permits of a unification of practice in a number of shops because of the information it produces. It brings in the right kind of competition, based upon a comparison of costs of the same work of various shops. With it a superintendent is prepared to go to his manager with a request for a new wheel lathe, prepared to state that he can save its cost in 16 months; and what is more, he can prove his statement. This is far better than to ask for a new one "because the old one is worn out," and it brings into railroad work the principle which leads successful manufacturers to discard old and introduce new facilities—because they will pay.

When properly administered, piecework is the best friend of labor. It renders combinations of workmen for protection unnecessary by removing the cause of the combination, and the necessity for protection.

"It is a familiar fact that the unbelievers in piecework to-day become its ardent supporters to-morrow. The skepticism of honest men unfolds the truth, and becomes the conviction of the aftertime."

We acknowledge the assistance of Mr. J. F. Deems, Superintendent of Motive Power, and Mr. R. T. Shay, General Piecework Inspector, of the Chicago, Burlington & Quincy Railroad, in the preparation of this article.

The timber used in the construction of the new British Westinghouse plant comes from the United States, and it is said that some of the window frames were placed in the walls eight weeks after the order was filed in this country. The construction work is being done by 2,600 British workmen under the direction of seven American foremen and it will be completed within a year, whereas English builders wanted five years to complete it.

At the present time the total railroad mileage in the United States and Canada which is equipped with block signals is 3,347. "A year ago," says the "Railroad Gazette," "we published a detailed statement showing that block signals were used on less than 2,300 miles. The increase during the year has been nearly 50 per cent. There is enough new work now under construction or soon to be built, to make a total of over 4,000 miles, which is 65 per cent. more than the actual mileage in use at the close of the year 1900."

COMMUNICATIONS.

TREATMENT OF SPECIAL APPRENTICES IN THE SHOP.

To the Editor:

After reading your comment upon the fact that few college graduates are entering railroad work, I think that I can add another fact which is keeping young men from this particular line of work. I know from my own and from the experience of a great many of my friends that the treatment given to special apprentices in railway shops by the machinists and helpers is of the very worst kind. They seem to think that we are a detriment to their welfare, and accordingly are treated as such. This is more noticeable in the South and West, I find. I know of plans that have been carefully laid where parts of the engines and tools should fall on special apprentices, and had they been carried out might have been serious. They are cursed from 7 A. M. to 6 P. M., and then are made the subject of radical discussion at union meetings. It is not at all strange to me that this keeps a great many young men away from railroads, where low wages would not. A. A. G.

[Editor's Note.—Our correspondent is undoubtedly correct, but is this not one of the difficulties to be overcome by the special apprentices themselves?]

SALARIES OF MOTIVE POWER OFFICERS.

To the Editor:

Permit me to congratulate you on your plea for the adequate remuneration of motive power men (page 39, February 1902). I had never taken time to consider how shabby our treatment has really been. One of the cases you describe must be mine, as I am master mechanic of a division that was formerly "a whole railroad by itself," operating upwards of one hundred engines.

Not only do the engines, two shops, six round-houses, and the water service come under my jurisdiction, but the car shops and a dozen interchange points furnish diversion for my spare moments. Yet I probably have the easiest division, as far as legitimate work goes, of all on the system.

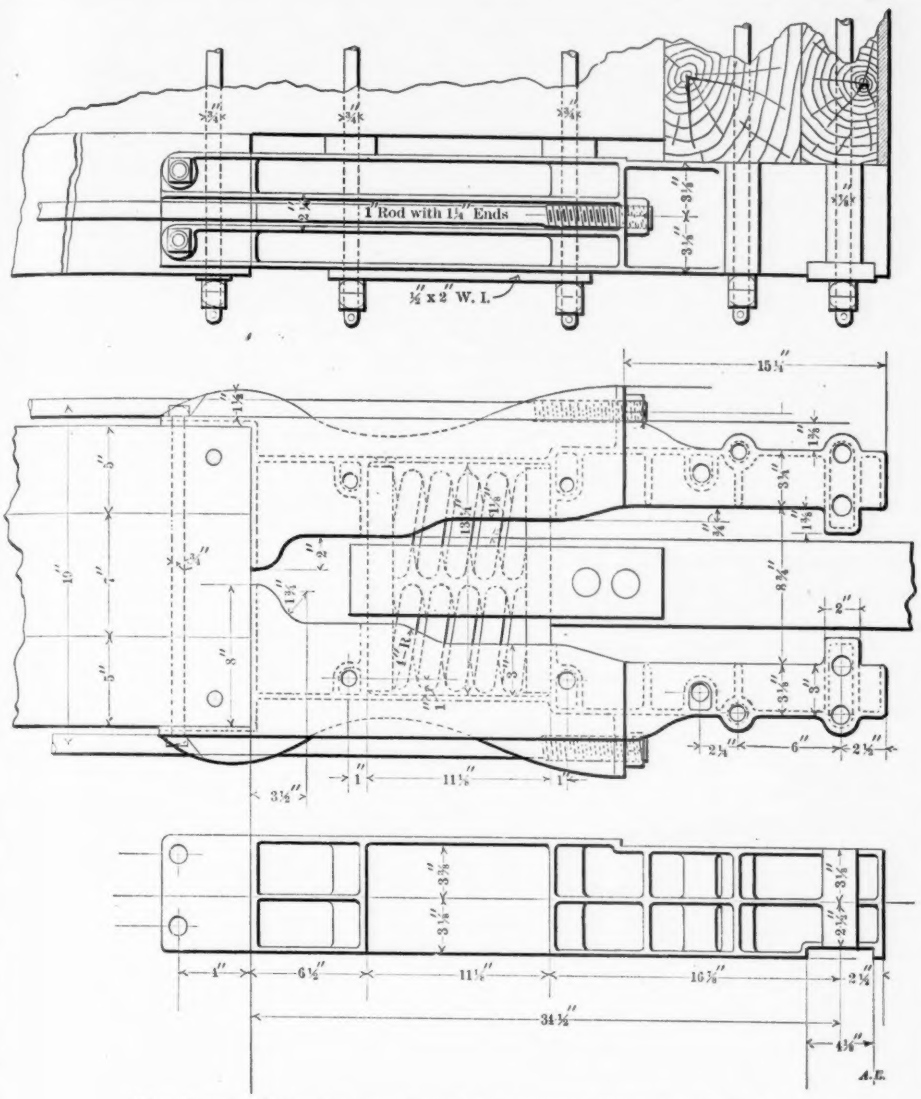
I started out some eighteen years ago with a high school education and a chance to watch the building of locomotives while I swept out the office and made the blue-prints. Eventually I lost some of the awe in which I held egg-shell paper and tracing cloth, and after having contracted "draftsman's hump," eradicated the same by use of the hammer-and-chisel. Meanwhile I had burnt a modicum of midnight oil in scraping a passing acquaintance with a few foreign and domestic celebrities, such as Reuleaux, Clark, Thurston and DuBois, so that, while I still look wise and say nothing when the youth with the sheepskin hurls quarternions at me, I do not recall that I ever determined the clearance of a piston-valve engine by pouring water into the steam port until it rose level with the bottom of the valve, or put ⅛ in. inside and ⅝ in. outside lap on an express engine.

I have held a variety of positions in machine shop, foundry, drafting-room and office, and have yet to receive the first request for my resignation, every move I have made so far being for more experience or additional money; yet here, in charge of 400 men, and responsible for the expenditure of nearly one million dollars annually, my check is less than one per cent. of the pay-roll, and many a runner, responsible for one engine only, goes out of the pay car with more money than I do.

Yet such is the glamor of the business that not long ago I refused an offer to take charge of a machine shop employing less than 100 men on work that I am thoroughly familiar with, at a salary of double my amount and a chance to get an interest in the business.

Were my case peculiar, I should lay the scanty remuneration to my own lack of ability or other shortcomings, but I know dozens of men in the same fix. On this very road there is a young man, a better executive, with better training, and a brighter engineer than myself; he has almost twice the number of engines to operate under much more difficult conditions, yet his salary is no more than my own.

MASTER MECHANIC.



Needham's Malleable Iron Draft Attachment—Wabash Railroad.

NEEDHAM'S MALLEABLE IRON DRAFT ATTACHMENT

Wabash Railroad.

A drawing of a new malleable iron draft attachment, in use on the Wabash Railroad, has been received from Mr. C. S. Needham, General Foreman of the car department of that road. Its construction is clearly indicated in the engraving. This form of casting offers over 54 sq. ins. of buffing surface for each casting. It also offers means for binding the wooden timbers and filling blocks together and supplies a rear guide for the coupler yoke. Other objects of the designer were to provide large bearing areas for the followers, render the attachments easy to apply to old cars without trimming or fitting, to make each draft attachment in one piece with a minimum number of bolts and other parts, to take the standard couplers and yokes, and to provide an inexpensive and durable draft gear. Draft rods may be passed through the lugs and extended as far as the needle beams, or they may be extended the entire length of the car.

The idea of putting apprentices on three months' trial before allowing them to begin their term is suggested by a writer in the "American Machinist" who has evidently had a very unsatisfactory experience. To succeed in any work one needs to be adapted to it, and a period of probation would permit of selecting candidates who are worthy of the training.

LARGE BORING AND TURNING MILL.

William Sellers & Company, of Philadelphia, have designed and constructed for the Westinghouse Electric and Manufacturing Company a large boring and turning mill, which has several interesting features. The housings are so placed as to permit of work 28 ft. in diameter being swung. The crossrail has been designed with special reference to withstanding the powerful torsional stresses produced when the boring bars are extended for deep boring and turning. The housings are of rectangular section, the front and back edges being parallel and the crossrail is extended back to the rear face of the housings, where an additional pair of elevating screws and clamping shoes are provided. The crosshead bar measures 7 ft. 6 ins. from the front fact of the housings to the clamping point on the rear, while its depth is 40 ins. When this great beam, braced by internal diagonal webs, is secured to the front and back of the housings, it affords a degree of rigidity not hitherto obtained in this class of machine. In fact, when the crossrail is clamped up for work no connection would be needed between the upper ends of the housings as far as securing stiffness is concerned. The front of the crosshead is further stiffened by a curved beam over 43 ins. deep in the middle, and bolted to the top of the crossrail between suitable cast abutments.

Each saddle carries its own feeding mechanism, with change wheels for the speeds of the feed, and there are, within the crossrail, two shafts from which power may be taken. The saddles can be moved along the crossrail, or the bar be raised or lowered by rapid power traverse with great nicety. The operating levers are so interlocked that the rapid traverse cannot be thrown in for one saddle unless it is disengaged from the other, so that it is impossible for the operator on one head to move the opposite head accidentally. The great length of the crossrail makes it necessary to provide intermediate bearings, and ingenious drop hangers are provided, which move out of the way as the saddles travel along; when in action they hold the shafts effectively in closed bearings.

The pension system has been in operation on the Pennsylvania Railroad for about two years. A recently issued statement shows that there was an amount authorized to be paid to retired employees, aggregating during 1901 the sum of $292,290.20, and this, added to allowances paid during 1900, gives a total of $536,310.17. These disbursements are met by an annual appropriation of $300,000. Since the creation of the pension department, 1,574 employees have been retired and pensioned. Of these 217 died prior to December 31, 1901. Out of the total number who were retired 248 were in the 65 to 70-year class.

At a cost of between $15,000 and $20,000 the Boston & Maine management has again gratuitously supplied its employees with new uniforms.

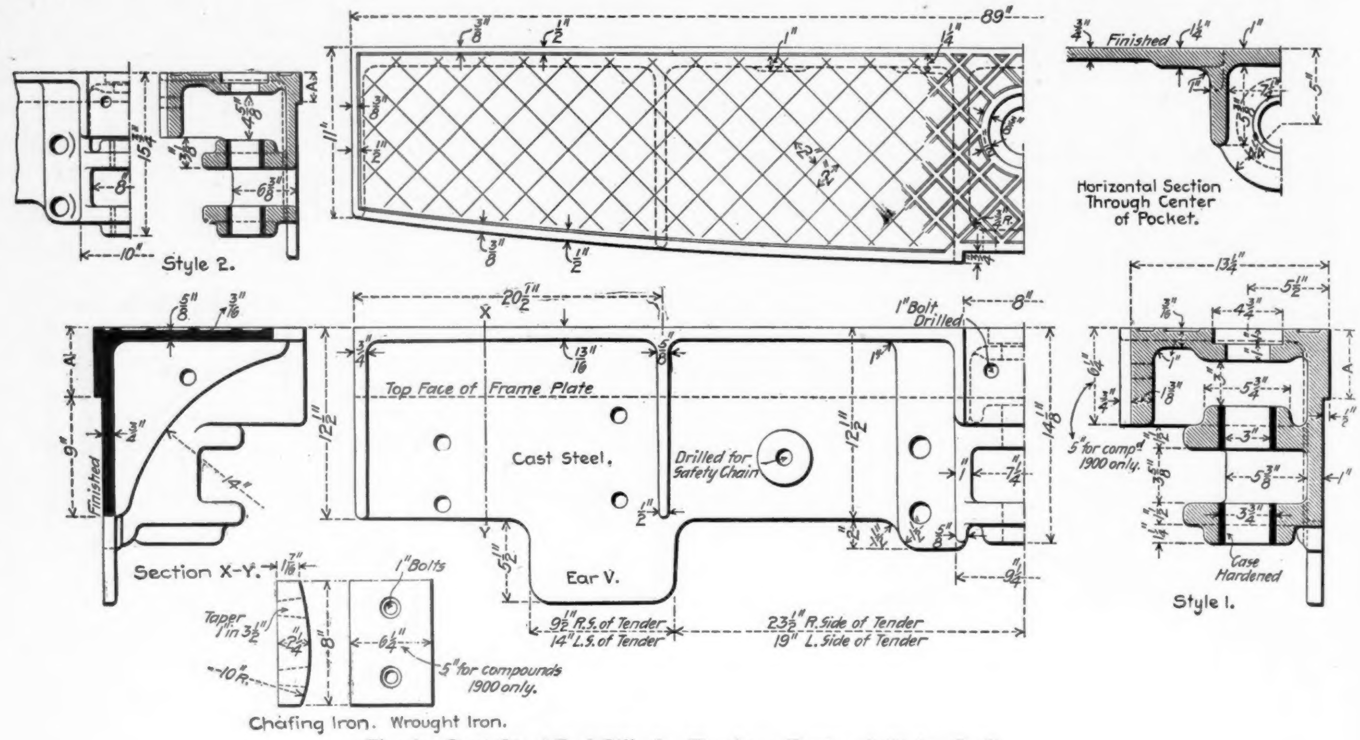


Fig. 1.—Cast Steel End Sills for Tenders—Boston & Maine R. R.

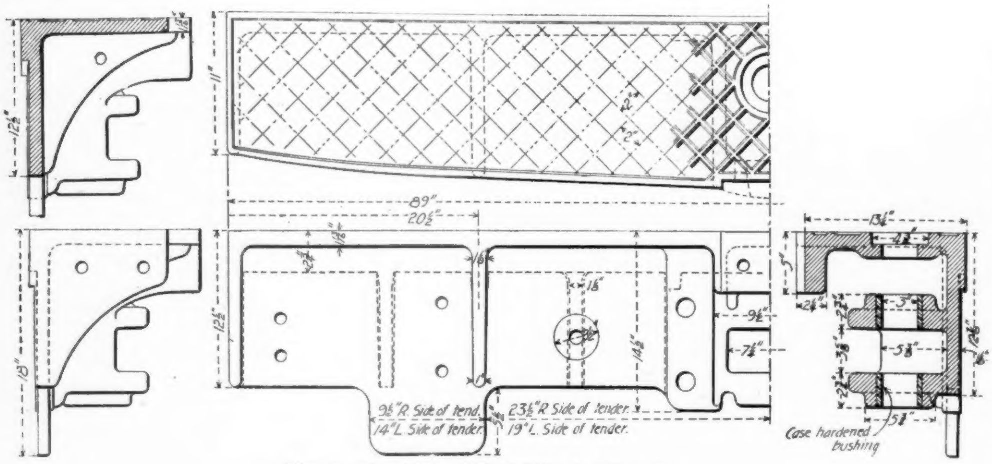


Fig. 2.—Cast Steel End Sills for Tenders.

CAST STEEL END SILLS FOR TENDERS.

Boston & Maine Railroad.

The difficulty in obtaining oak for the purpose has led to the use of cast steel end sills for tenders on the Boston & Maine, which are made in accordance with the drawing from which the accompanying engraving, Fig. 1, was prepared. Mr. Henry Bartlett, Superintendent of Motive Power of the road, has kindly furnished the information and states that the weight of the casting illustrated is 735 pounds when rough. The casting, Fig. 1, is secured to the tender frame by bolts and the features of the construction are plainly shown in the engraving. The plan permits of saving a number of parts and tends to increase the life of the frame. The draw head and chafing plate are embodied in the steel casting and the arrangement of the ends is favorable to a satisfactory step, which is not true of the ordinary thick oak end sill. The wear of the coupling pin is taken on case hardened bushings and as this is the only wear to be provided for the casting appears to be likely to outlast all other parts of the tender. These castings are applied to all new tenders.

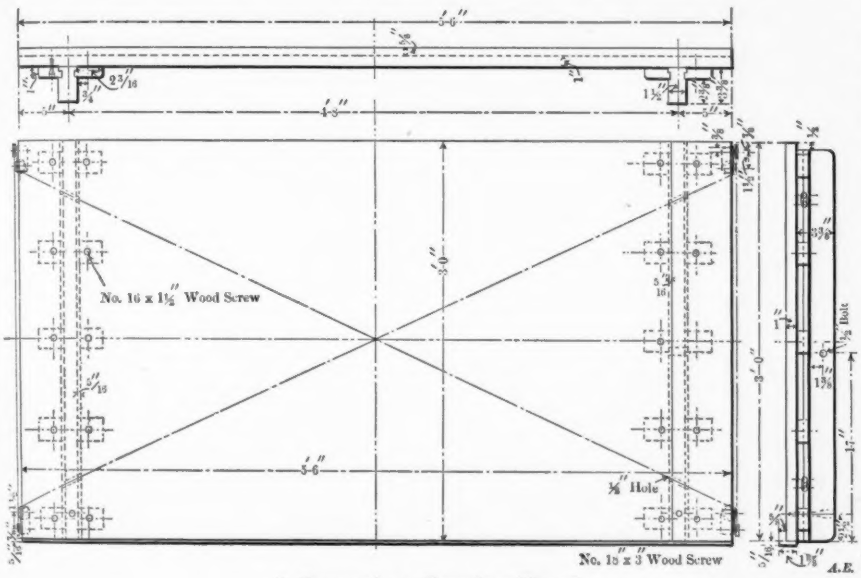
Fig. 1 gives the leading dimensions, those which are changed to suit various tenders are indicated by the letter "A." The ear "V" is used on 19-ft. tenders only. Style 1 is used on all but the latest 18-ft. switcher tender, designed this year and these end sills are fitted to all tenders having steel frames. Fig. 2 illustrates the experimental sill from which the present standard was developed. The first one weighed 1,090 lbs. when finished and it will be noted that the flanges and webs have been thinned to save weight.

Mr. Bartlett has had these end sills in service for over a year with entirely satisfactory results. Some of them have had rough usage in derailments, especially on switching engines, but they have passed through the ordeal successfully and none have been removed. From present indications it appears that only a serious collision will break them.

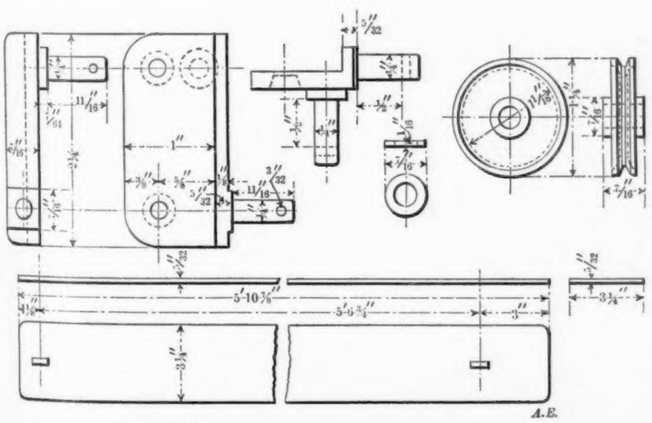
"To feel the pressure of work is a cause for thankfulness. The time when we are busiest is the time we are most likely to do our best. Often there comes the temptation to feel that, if we had more leisure, we could do more and better work, but experience usually shows that to be a mistake. The world recognizes this. It does not call on the men with most leisure when it wants an exceptional undertaking carried through. No employer in any walk of life looks among the ranks of those with plenty of time to spare when he would fill a position. He wants one who is already numbered among the busiest, who is demonstrating that he has a right to live by shouldering his full share of this world's activities, and whose powers are at their best through their exercise. To keep busy is to keep in training, and that is the secret of attainment as truly in the race of life as on the athletic field."

A CONVENIENT DRAWING BOARD.

The drawing board shown in the accompanying engraving is made of well-seasoned white pine, with strip battens and clamps of hardwood. It is provided with a wooden straight edge 3½ ins. wide by 5/32 ins. thick, extending the full length of the board. To operate the straight edge an ingenious device is used, whereby the straight edge is held parallel at all times to the top and bottom edges of the board. From the engraving it will be seen that two 1¼-in. pulleys are attached to a small bracket at each corner of the board, one pulley having its face parallel with the edge, while the face of the other pulley is parallel to the under surface of the board. A continuous cord is passed over these pulleys at each corner of the board and crossed on the under side at the center. By crossing the cord in this manner any change in tension that



A Convenient Drawing Board.



Details of Pulley Casting and Straight Edge.

might occur will affect both ends of the straight edge equally and keep it parallel. A heavy cloth is used to cover the board when not in use. One end of the cloth is fastened to the upper edge of the board and the other end to a wooden roller. When the cover is rolled up, it rests in three small curved supports, which are fastened to the upper edge of the board. A pedestal, 3 ft. 3¾ ins. high, supports the drawing board at each end, where it is pivoted and allowed to swing to any desired angle. Mr. H. K. Griffith, Chief Draftsman of the Southern Railway, who developed the design, has used them for several years to good advantage in the drafting room of that road in connection with a 2-ft. 6-in. by 5-ft. flat-top table, which is convenient in referring to blue prints, and for the keeping of drawing instruments and materials.

EXPERIMENTS ON SPIRAL SPRINGS.

By Chas. H. Benjamin, Cleveland, O.

And Roy A. French, Pittsburg, Pa.

A Paper Read Before the American Society of Mechanical Engineers.

Our text books and our technical journals contain discussions and formulas, but very few data from which constants can be obtained to use in the formulas. In the experiments to be described, an attempt has been made to determine the coefficient of torsional elasticity and the safe stress for different sizes of bar and different ratios of mean diameter of spring to diameter of bar.

The following notation will be used

P = loads in pounds. S = torsional stress in pounds per square inch. G = coefficient of torsional elasticity. D = mean diameter of spring in inches. d = diameter of bar in inches. H = height of spring in inches. L = length of bar in inches. x = deflection in inches with load P.

Then, by the usual formulas for tension and compression springs:

$$P = \frac{255D}{Sd^3} \text{ and } x = \frac{Gd}{LDS}.$$

The springs tested were all made of tempered steel and were open coil, or compression springs. The results shown in the table were in every case obtained by testing a number of springs made as nearly alike as possible, and using the average loads and deflections for computation.

Every spring was first closed solid, coil to coil, several times in a hydraulic press, to remove all permanent set; then placed in a Riehlé testing machine and tested for capacity and corresponding deflection.

To illustrate, take for an example, group No. 1 in the table. This group consisted of 15 springs, 9.25 ins. outside diameter and 17.25 ins. free height before closing. The steel used was 1.3125 ins. in diameter and 150 ins. long before the ends were tapered. These springs were placed in the press one at a time and closed coil to coil twice under the full capacity of the press, 75,000 lbs. The pressure was then removed, and upon measuring they were found to average 15.25 ins. in height, showing a set of 2 ins. They were then closed twice more, but took no further set. A spring closed solid with 100 per cent. overload should take all its permanent set with two closings.

The springs were then placed in the testing machine and the load and total deflection measured. The average load necessary to close them was found to be 10,900 lbs., and the corresponding deflection was 7.0625 ins. When taken from this machine the free height was again measured, but they had taken no more set.

For substitution in the formulas we then have:

$$P = 10.900.$$
$$d = 1.3125.$$
$$D = 9.25 - d = 7.9375.$$
$$x = 7.0625.$$
$$L = 150.$$

Substituting and solving for S and G:

S = 97,500 = the torsional stress in pounds per square inch when the spring is closed coil to coil, and G = 12,500,000, the coefficient of elasticity. Dividing the mean diameter of the spring by the diameter of the bar gives a ratio which will be called R, in this case equal to 6.05. Dividing the permanent

RESULTS OF TESTS OF A NUMBER OF SPRINGS.

Group	Number of springs. N	Outside diam. O	Mean diam. D	Diam. of bar. d	Ratio = D/d R	Length of bar. L	Height before closing. H	Height after closing. H'	Perman't set = H — H'. S	Height when closed. H"	Total action = H' — H". x	Ratio = S/x Y	Load to close spring. P	Coefficient of torsional elasticity. G	Torsional or shearing stress S
1	15	9.25	7.9375	1.3125	6.05	150	17.25	15.25	2	8.8175	6.432	.311	10,900	12,500,000	97,500
2	20	6.625	5.375	1.25	4.3	80	7.125	7	.125	5.9375	1.062	.117	6,375	14,400,000	44,700
3	12	6	4.75	1.25	3.8	67	7.875	7.5	.375	5.875	1.625	.23	16 600	16,150,000	103,000
4	6	5.25	4.125	1.125	3.67	89	10.75	10.125	.625	7.625	2.5	.25	13,800	13,400,000	102,000
5	20	4.75	3.625	1.125	3.23	75	9.875	9.375	.5	7.25	2.125	.235	17,000	12,500,000	110,000
6	40	7.75	6.625	1.125	5.9	100	7.875	7.625	.25	5.5	2.125	.117	4,850	15,800,000	57,500
7	36	5	3.9375	1.0625	3.7	61	7.5	6.9375	.562	5.375	1.567	.36	12,000	14,400,000	100,000
8	64	5.5	4.4375	1.0625	4.18	101	11.125	10.6875	.437	7.625	3.062	.142	12,000	15,100,000	113,000
9	24	4.375	3.3125	1.0625	3.1	48	6.5	6.125	.375	5	1.125	.333	14,800	13,700,000	104,000
10	6	6	5	1	5	84	8.625	8.125	.5	5.625	2.5	.2	8,000	17,100,000	102,000
11	20	4.5	3.5	1	3.5	79	9.875	9.4375	.437	7.25	2.187	.201	12,500	14,100,000	111,800
12	16	4.25	3.25	1	3.25	49	6.5	6.125	.375	4.875	1.25	.3	13.100	13,800,000	109,000
13	36	4.75	3.75	1	3.75	37	4.5	4.125	.375	3.25	.875	.43	12,000	18,100,000	114,400
14	35	4.187	3.25	.9375	3.48	50	6.5	6	.5	4.75	1.25	.40	10,500	14,700,000	106,000
15	800	4.5	3.625	.875	4.15	57	6.375	6	.375	4.4375	1.562	.24	6,250	13,100,000	86,500
16	8	3.75	2.875	.875	3.28	41	5.375	5	.375	4.125	1.875	.43	10,800	18,100,000	118,000
17	24	4	3.125	.875	3.58	60	7.375	7	.375	5.4375	1.562	.24	8 650	13,900,000	103,000
18	40	4	3.125	.875	3.58	51	6.5	6	.5	4.625	1.375	.364	12,000	18,900,000	143,000
19	24	3.375	2.625	.75	3.5	62	7.25	7	.25	5.655	1.345	.186	5,250	13,500,000	83,500
20	8	5.75	5	.75	6.67	172	17.625	16	1.625	8.4375	7.562	.212	2,850	13,100,000	86,500
21	8	4.5	3.75	.75	5	84	8.5	8	.5	5.5	2.5	.20	4,000	15,200,000	91,000
22	12	3.5	2.75	.75	3.67	53	6.375	6	.375	4.625	1.375	.273	6 950	16,200,000	115,000
23	4	4	3.25	.75	4.33	44.5	5.75	4.6875	1.0625	3.0625	1.625	.655	6,500	15,400,000	127,000
24	24	3.5	2.875	.625	4.6	68	7.375	7	.375	4.6875	2.312	.162	3,250	13,600,000	97,500
25	100	3.25	2.625	.625	4.2	37.5	4.375	4	.375	2.8125	1.187	.316	4,225	15,500,000	116,500
26	100	3.25	2.625	.625	4.2	43	4.75	4.5625	.187	3.375	1.187	.158	4,000	16,700,000	109,500
27	200	3.5	3	.5	6	108	9.75	9.625	.125	5.8125	3.812	.032	1,250	12,900,000	76,500

set by the working deflection gives another ratio, which will be called Y. In this case, Y = .283.

In a similar manner were calculated all the results given in the table.

Additional notation used in table:

N = number of springs in group.
O = outside diameter in inches.
H = height before closing in inches.
H' = free height in inches after producing set.
H" = height in inches when closed solid.
s = H — H' = permanent set in inches.
x = H' — H" = total action in inches.

The value given for G in most hand books is 12,000,000. The larger values shown in the tables are doubtless due to the higher grade of steel used. The variation in values of G is probably due to differences in temper, although in some cases the chemical constituents of the steel may have varied slightly. The average value is found to be 14,700,000, which may be written 14,500,000 for convenience.

The proper stress is a more difficult thing to determine. A wide range of stresses was used in the springs experimented with. In each case the stress was that believed to be the best for the conditions under which the spring must work.

In some few cases, as in No. 18, it was necessary to use an abnormally high value to meet the conditions. This necessitated a special grade of steel, and great care in manufacture. Such a spring is not safe when subjected to sudden and heavy loads, or to rapid vibrations, as it would soon break under such treatment; if merely subjected to normal stress, it would last for years.

It will be noticed, by comparing columns S, Y and R of the table, that Y varies with both S and R for the same diameter of bar; that is, if R is constant, S and Y increase together, and if S is constant, R and Y increase together. There are some exceptions to this rule noted, but it is believed to be generally correct. This being true, a spring with its mean diameter small, as compared with size of bar, will allow a higher stress with less proportionate set than one of a larger mean diameter. An excessive set means injury to the material, and liability of failure.

Springs of a small diameter may safely be subjected to a higher stress than those of a larger diameter, the size of bar being the same. The safe variation of S and R cannot yet be stated.

There is an important limit which should be here mentioned. Springs having too small a diameter as compared with size of bar are subjected to so much internal stress in coiling as to weaken the steel. A spring, to give good service, should never have R less than 3.

The size of bar has much to do with the safe value of S; the probable explanation is this: A large bar has to be heated to a higher temperature in working it, and in high carbon steel this may cause deterioration; when tempered, the bath does not affect it so uniformly, as may be seen by examining the fracture of a large bar.

The above facts must always be taken into consideration in designing a spring, whatever the grade of steel used. A safe value of S can be determined only by one having an accurate knowledge of the physical characteristics of the steel, the proportions of the spring, and the conditions of use.

For a good grade of steel the following values of S have been found safe under ordinary conditions of service, the value of G being taken as 14,500,000.

For bars below ⅜-in. diameter:

R = 3 S = 112,000
R = 8 S = 85,000

For bars 7/16 to ¾ in. in diameter:

R = 3 S = 110,000
R = 8 S = 80,000

For bars from 13/16 to 1¼ ins. in diameter:

R = 3 S = 105,000
R = 8 S = 75,000

For bars over 1¼ ins. in diameter a stress of more than 100,000 should be used. Where a spring is subjected to sudden shocks a smaller value of S is necessary.

As has been noted, the springs referred to in this paper were all compression springs. Experience has shown that in close coil or extension springs the value of G is tne same, but that the safe value of S is only about two-thirds that for a compression spring of the same dimensions.

Mr. Andrew Carnegie has recently given $100,000 to the Stevens Institute of Technology, as an endowment for the engineering laboratory. This laboratory was built by money donated by Mr. Carnegie. It cost $65,000. Not long ago Mr. Henry Morton, president of Stevens, invited Mr. Carnegie to the dedication of the new laboratory, and the latter expressed himself as surprised that a school of technical training could be so complete and practical as this one is; the favorable impression made by this visit is, no doubt, responsible for the endowment gift. The yearly interest will just about meet the running expenses.

Experiments in making coke from western coals are being conducted at the works of the Illinois Steel Company in Chicago. While no definite results have been announced, we are informed that the outlook is promising. If successful, this will become a most important factor in steel making, which will tend toward a movement of the steel making center toward the West.

PERSONALS.

Mr. W. H. Marshall, who has been superintendent of motive power of the Lake Shore & Michigan Southern for the past two years, has been promoted to the position of general superintendent, to succeed Mr. A. H. Smith. This seems to be another turning point in Mr. Marshall's interesting career, and another and greater advancement for which he is admirably prepared. He began as an apprentice at the Rhode Island Locomotive Works, and is a general superintendent at the age of 37 years. After completing his apprenticeship he entered the drafting room and soon became chief draftsman. After this he went to New York as a consulting mechanical engineer, and in January, 1888, went to Chicago as editor of the "Railway Review." Three years later he became editor of the "Railway Master Mechanic," and in 1896 edited the American Engineer and Railroad Journal. His first distinctive railroad experience began in June, 1897, when he was appointed assistant superintendent of motive power of the Chicago & Northwestern. Two years later he was called to the Lake Shore as superintendent of motive power, where his work has placed his name among those of the ablest motive power officers of the country. The class "J" prairie type, passenger locomotive, which he designed (see American Engineer, March, 1901), is sufficient of itself to give him such recognition. His experience and his thorough knowledge of motive power problems is an excellent preparation for operating responsibilities, and the appointment is exceedingly important, because it may be accepted as an indication of an appreciation of the real position of motive power in the operation of a railroad. Mr. Marshall's success seems to be due to a combination of honesty, personal ability, breadth of view, a recognition of the importance of the development of subordinates and a thorough knowledge of the problems which have confronted him. He has a thorough technical education which he obtained himself by individual study, and we have departed from our usual custom in announcing appointments, because Mr. Marshall's career should be brought before young men who have had far better advantages.

Mr. H. F. Ball has been promoted from the position of mechanical engineer to that of superintendent motive power of the Lake Shore & Michigan Southern Railway, to succeed Mr. W. H. Marshall. Mr. Ball began his railroad work as an apprentice in the Pennsylvania shops at Altoona in 1884. In 1888 he entered the drafting room there, and in 1890 became chief draftsman of the car department of the Lake Shore & Michigan Southern. In 1892 he took charge of the car shops at Cleveland as general foreman. In 1894 he became general car inspector and was appointed mechanical engineer in 1899. He comes to the responsibilities of the motive power department with an excellent preparation and with the important advantage of a thorough knowledge of the road. Appointments to such important offices are so seldom made from the subordinate positions as to cause comment. The appointment seems to be as wise as it is pleasing.

The New York Central announces the following appointments in its motive power department: Mr. G. H. Haselton is appointed division superintendent motive power at West Albany, succeeding Mr. Angus Brown, deecased; Mr. John Howard is appointed division superintendent motive power at Depew, succeeding Mr. G. H. Haselton, promoted; Mr. E. A. Walton, master mechanic river division, is appointed division superintendent motive power at Corning, succeeding Mr. John Howard, promoted. Of these, Mr. Walton's rise has been the most rapid. He entered the service of this road as general foreman at Oswego in 1899 and was made master mechanic of the river division a year ago.

Mr. John R. Slack, for some time assistant superintendent of motive power of the Delaware & Hudson, has been appointed superintendent of motive power. He was educated at Columbia College and later at the Stevens Institute of Technology. He began railroad work in 1886 as an apprentice in the New York Central shops. Four years later he became locomotive inspector and mechanical engineer. In 1899 he became assistant superintendent of motive power of the Delaware & Hudson, from which position he has been promoted.

Mr. G. R. Henderson, superintendent of motive power of the Atkinson, Topeka & Santa Fe, has appointed Mr. F. N. Risteen mechanical superintendent of the Eastern Grand Division, with headquarters at Topeka. Mr. C. M. Taylor has been appointed mechanical superintendent of the Western Grand Division, with headquarters at La Junta, Colorado. Mr. James Collinson having resigned as general master mechanic, the position has been abolished. The division master mechanics report to the mechanical superintendent of their respective grand divisions.

Important changes on the New York Central and the Lake Shore have called Mr. W. C. Brown to New York as third vice-president of the New York Central, where he will have charge of the transportation, engineering, mechanical and purchasing departments, but he retains the position of vice-president of the Lake Shore. Mr. P. S. Blodgett returns to the Lake Shore as general manager, and is succeeded as general superintendent in New York by Mr. A. H. Smith, formerly general superintendent of the Lake Shore. Mr. W. H. Marshall succeeds Mr. Smith as general superintendent of the Lake Shore, as noted elsewhere, and Mr. H. F. Ball, formerly mechanical engineer, succeeds Mr. Marshall as superintendent of motive power.

Mr. F. H. Stark, formerly master car builder of the Cleveland, Lorain & Wheeling, has been appointed general foreman of the car department of the Baltimore & Ohio, at Baltimore, Md. This change has been necessitated by the purchase of the C. L. & W. Ry. by the Baltimore & Ohio Railroad. Mr. Stark was formerly with the Lake Shore; Cincinnati, Hamilton & Dayton; Consolidated Rolling Stock Company; Wheeling & Lake Erie, and the C. L. & W. railways.

Mr. Thomas Paxton has been appointed superintendent of motive power of the Colorado & Southern, with headquarters at Denver, Col. He succeeds Mr. A. L. Humphrey, resigned. Mr. Paxton leaves the Gulf, Colorado & Santa Fe, with which road he has been connected since March, 1901, holding the position of master mechanic. He was for three years master mechanic of the Chicago Division of the A., T. & S. F., and for seven years he was master mechanic of the middle division. Mr. Paxton's connection with the Santa Fe system dates from April, 1884.

Mr. Willard A. Smith, president of the "Railway and Engineering Review," of Chicago, has been appointed chief of the Department of Transportation at the St. Louis Exposition, commemorating the Louisana Purchase. Mr. Smith contributed to the success of the World's Fair at Chicago, the Pan-American Exposition at Buffalo in similar capacities, and had charge of the American engineering and transportation exhibits at the recent Paris Exposition. He will continue in the active management of the "Railway and Engineering Review."

From the Chicago & Northwestern Railway we learn that Mr. A. B. Quimby has been appointed master mechanic of the Northern Iowa Division, with headquarters at Eagle Grove, Iowa, also that Mr. E. H. Wade has been appointed assistant master mechanic of the Wisconsin and Northern Wisconsin Divisions, with headquarters at Fond du Lac, Wis., to succeed A. B. Quimby, promoted.

Mr. Harry Ashton has been appointed master mechanic of the Moncton locomotive shops of the Intercolonial Railway of Canada.

Mr. Spencer Otis has been appointed Western representative of the American Locomotive Company, with office in the Fisher Building, Chicago. Mr. Otis was formerly the acting representative of the Rhode Island Locomotive Works.

Mr. J. F. Deems has resigned as superintendent of motive power of the "Burlington" to become general superintendent of the American Locomotive Company at Schenectady. This step removes from railroad service one of the very ablest motive power officers and one the service can ill afford to lose. In our judgment Mr. Deems has no superior in the management of men in the motive power department, and this change should make managing officers thoughtful. That which renders Mr. Deems valuable to his new employers is precisely that which makes him valuable to the railroads—the ability to conduct his department on a business basis. His success lies in his knowledge of men and his fair and considerate treatment of them. His personality and influence reach beyond the work of the men, touch their attitude toward their employers and even go into their homes. He has introduced piecework on the "Burlington" and made it a success under unusually difficult conditions. Nothing more than this need be said of his methods. Mr. Deems has always been a student, though not a graduate of a technical school. He began on this road as a machinist at Beardstown, Ill., and has been advanced very rapidly. We heartily congratulate the American Locomotive Company upon securing his services, and cannot forbear saying that the railroads have only themselves to blame when they lose such men. Motive power positions should be such that they will attract and hold the best men to be found.

Mr. F. H. Clark has been promoted from the position of mechanical engineer of the Chicago, Burlington & Quincy to that of superintendent of motive power, to succeed Mr. J. F. Deems. Mr. Clark was educated as a mechanical engineer and was for a number of years associated with the late David L. Barnes in consulting engineering work in Chicago. About seven years ago he entered the service of the "Burlington" at Aurora as chief draftsman of the motive power department, and succeeded Mr. William Forsyth as mechanical engineer. Mr. Clark has held that position until now. This promotion, following so closely that of Mr. Ball, on the Lake Shore, indicates an appreciation of the importance of mechanical engineering in connection with railroads, and is an encouraging recognition of the office of the mechanical engineer. We cannot avoid observing in connection with this appointment that the entire organization of the road must necessarily be strengthened by a promotion of this kind. Mr. Clark is well prepared for his new responsibilities and it is a pleasure to record his appointment. It is high honor to succeed such men as Messrs. Rhodes, Delano and Deems, and one of which Mr. Clark is thoroughly worthy.

Chicago ranks fourth among the principal ports of the world, in the tonnage of arrivals and clearances, with 14,186,100 tons. London, New York and Hamburg stand above it. So far as the United States is concerned Chicago leads all ports except New York. It handles more than three times the tonnage of Boston, almost four times the tonnage of Philadelphia and more than four times that of Baltimore. In the thirty years since 1870 the tonnage has more than quadrupled, but it is nevertheless a fact that the annual total of arrivals and clearances has decreased by nearly 8,000, due to the increase in the size of the vessels. Fewer boats are used than formerly, but they carry much more.

TESTS OF BEAUMONT (TEXAS) OIL.

Oil from the Beaumont district of Texas was recently tested by Prof. J. C. Denton, of Stevens Institute of Technology, for Mr. H. M. McDonald, of New York. The tests were made in New York City in comparison with coal, under a return tubular boiler 6 ft. in diameter by 18 ft. long, having 1,900 sq. ft. of heating surface. The burner used was devised by Mr. T. H. Williams, and is illustrated by the accompanying engraving. From the tests the following conclusions were drawn:

For a range of from 112 to 220 horse-power the total evaporation from and at 212° per pound of oil varied from 15.71 to 15.29 lbs. of dry steam, and the burner consumption varied from 3.1 to 4.8 per cent. of the boiler output, so that the net evaporation ranged from 14.74 to 15.16 lbs. of water per pound of oil.

The combustion of the oil by the burner was practically perfect, since by the evidence of the heat balance the heat accounted for by the steam production, the hot gases flowing to the chimney, and a reasonable allowance for radiation represent about 98 per cent. of the total heat of combustion of the oil when burned in oxygen in a calorimeter.

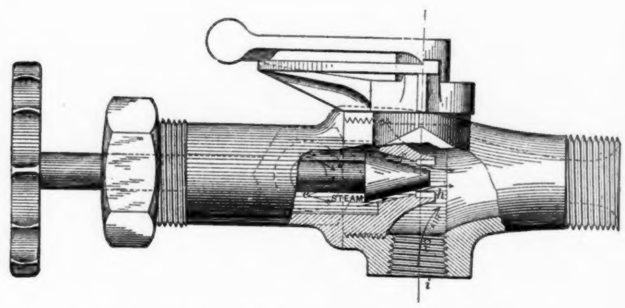


Fig 1.—Horizontal Section of Williams Burner.

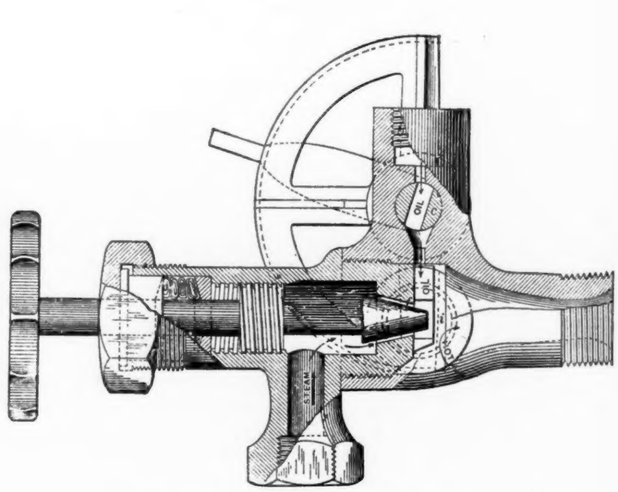


Fig. 2.—Vertical Section of Burner.

The boiler utilized about 78 per cent. of the heat of the fuel, which represents the best average boiler practice, and the percentage of steam consumed by the burners is a minimum for steam-jet burners. An excess of cold air probably caused a loss of evaporation for the smaller horse-power, but for the 189 and 220 horse-power tests there was no excess of the air necessary for complete combustion. Consequently for the two higher horse-powers the net evaporation of 14.8 pounds of water per pound of oil may be considered to represent the best

economy that is to be expected from the use of the oil as a fuel with steam-jet burners.

The evaporation from and at 212° per pound of coal was 9.17 and 8.94 lbs. of water for 93 and 119 horse-power. The coal afforded 11.6 per cent. of ash, and 14,680 B. T. U. per pound of combustible when burned in oxygen in a calorimeter, which represents an excellent No. 1 buckwheat.

The comparative fuel costs of coal and oil for the particular conditions of the ice factory where the tests were conducted are therefore as follows: (A) For producing the horse-power required by the factory, or one horse-power per about 20 sq. ft. of heating surface, with the moisture and ash as found:

1.	Moisture in coal, per cent	6.2
2.	Ash, per cent	16.2
3.	Weight of oil per gallon, lbs	7.66
4.	Weight of oil per barrel of 42 U. S. gallons, lbs	322
5.	Evap'n per pound of wet coal from and at 212 deg., lbs	9.17
6.	Net evap'n per lb. of oil from and at 212 deg., lbs	1.51
7.	Ratio of oil to coal $\frac{15.1}{9.17}$ =	1.65
8.	Number of barrels of oil equivalent to 2,240 lbs. of coal	4.23
9.	Price of coal per 2,240-lb. ton, without cartage and cost of ash removal	$3.00

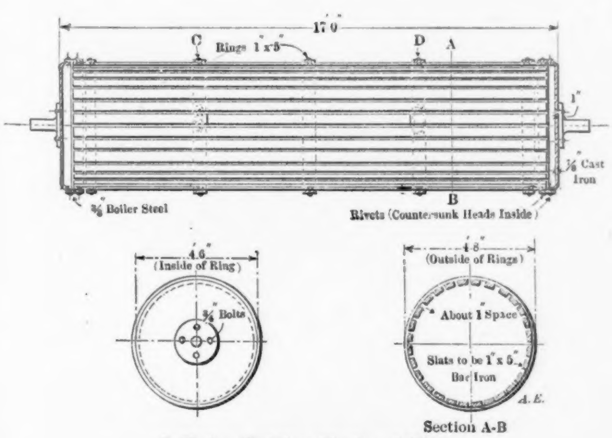
(B) For producing horse-power upon the commonly guaranteed basis of 1 horse-power per 10 sq. ft. of heating surface, and with an average percentage of moisture and ash in the coal:

10.	Equivalent price of oil per barrel of 42 U. S. gallons	$0.71
1.	Moisture in coal, per cent	3
2.	Ash, per cent	17
3.	Evap'n per lb. of wet coal from and at 212 deg., lbs	8.75
4.	Net evap'n per lb. of oil from and at 212 deg., lbs	14.8
5.	Ratio of oil to coal $\frac{14.8}{8.75}$ =	1.69
6.	Number of barrels of oil equivalent to 2,240 lbs. of coal	4.12
7.	Price of coal per 2,240-lb. ton, without cartage and cost of ash removal	$3.00
8.	Equivalent price of oil per barrel of 42 U. S. gallons	$0.73

The oil was tested, chemically, from samples from each barrel as it was delivered, with the following results from the mixture:

Specific gravity		0.920	
Flash point		142°	F.
Burning point		181°	F.
Cold test		— 6°	F.
Calorific value per pound by oxygen calorimeter		19,060	B. T. U.
Chemical Composition	Carbon	84.60	per cent.
	Hydrogen	10.90	"
	Sulphur	1.63	"
	Nitrogen	0.00	"
	Oxygen	2.87	"

Good Pittsburg coal contains as much as 1.7 per cent. of sulphur without damaging the boilers. With as much as 2.6 per cent. of sulphur this oil will give about as much as the



A Tube Rattler Made of Slats.

coal for equal horse-powers, but this proportion is considerably greater than is actually contained in this oil. Good Indiana coal contains as much as 3.5 per cent. of sulphur, which would be equivalent to 6.9 per cent. of sulphur in oil. This coal gives no trouble from the sulphur, which is sufficient ground for the claim that the oil will cause no deterioration from this source. In coal, sulphur causes clinker, but in oil there is no equivalent effect.

Oil has a great advantage in saving labor, because one man can tend 30 oil burners of 100 boiler horse-power each. With plants of 500 horse-power and over, a saving will be effected in the labor item. Under average conditions of coal and wages this will amount to about 15 cents per ton of coal for powers in excess of 500 horse-power, and in addition to this there is a saving in handling ashes and coal. Oil will be cheaper in labor charges than coal used in stokers, for plants of over 1,000 horse-power. The ash charge is about 10 cents per ton of coal used. In furnace repairs, this report gives oil the advantage of 2 cents per ton of coal used.

PLATE FOR LAYING OFF DUNBAR PACKING.

A convenient device for saving time in laying off Dunbar packing rings, devised by Mr. George Wales, is in use at the West Burlington shops of the Chicago, Burlington & Quincy Railway. It is in the form of a cast-iron plate 1 in. thick and 21 ins. in diameter, with circles scribed upon it for the variour sizes of pistons. The plate is drilled with ¼-in. holes

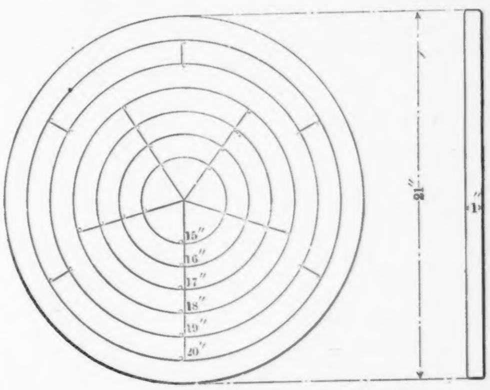


Plate for Dunbar Packing.

⅞ in. deep at intervals along the circles, and to these holes pins are fitted to hold the packing. A small metal T-square is used to mark the packing. The diameters of packing rings provided for range from 15 to 20 ins., inclusive, and the bore of each ring, to which the pins are set, is ⅝ in. less in diameter for each. The manner of using the plate will be apparent from the sketcn. With this device a man can lay off 125 rings in an hour, as compared with 7 rings an hour with dividers.

A TUBE RATTLER MADE OF SLATS.

An improved rattler for locomotive tubes, whereby the disagreeable dust and noise from this necessary part of every locomotive shop equipment is avoided, was illustrated on page 46 of our February number. Our attention has been called by Mr. Wagstaff, general boiler inspector of the New York Central, to a simple and effective construction, which is illustrated in the accompanying engraving. This rattler has two cast-iron heads, 4 ft. 8 ins. in diameter, connected by slats of 1 by 5-in. iron with intermediate support from three 1 by 5-in. rings, to which the slats are riveted. Mr. Wagstaff says that a rattler of this form was constructed by the Chicago & Northwestern some time ago, and was replaced by Mr. Westmark's device when the new boiler shop at Chicago was equipped. This one of slat construction may also be used under water, but it would be advisable to make a larger opening than that provided by the removal of one of the bars extending from ring C to ring D. Whether used under water or not this open rattler allows the dirt to fall away from the tubes and greatly facilitates and improves the work.

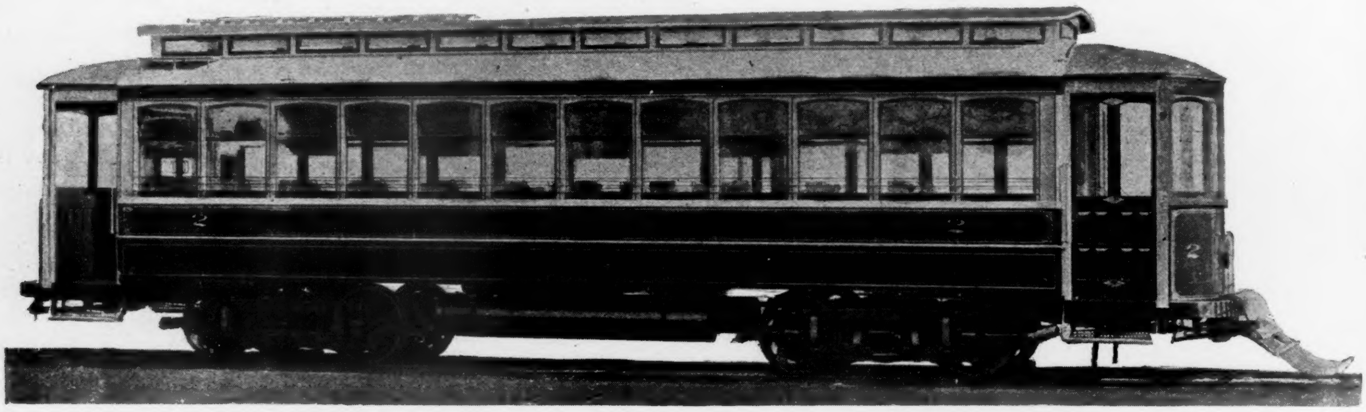
THE DEVELOPMENT OF PASSENGER CARS.

Passenger car construction is now undergoing an interesting development which is likely soon to bring out comparisons which should exert an important effect upon future practice, particularly on steam roads. Cars for suburban service on these roads are increasing in weight to an extent which in one extreme case requires a locomotive with 140,000 lbs. on the driving wheels for a train of six or seven coaches. These coaches have six-wheel trucks and weigh not less than 84,000 lbs. each, not far from half the weight being in the trucks. It is held that heavy equipment is required to meet the demand for smooth riding and for the comfort of the passengers. The development which this represents is along the lines followed in the long-distance fast-train service, and it means very heavy cars. Undoubtedly the practice of the Pullman Company in sleeping car construction is an influence in this direction.

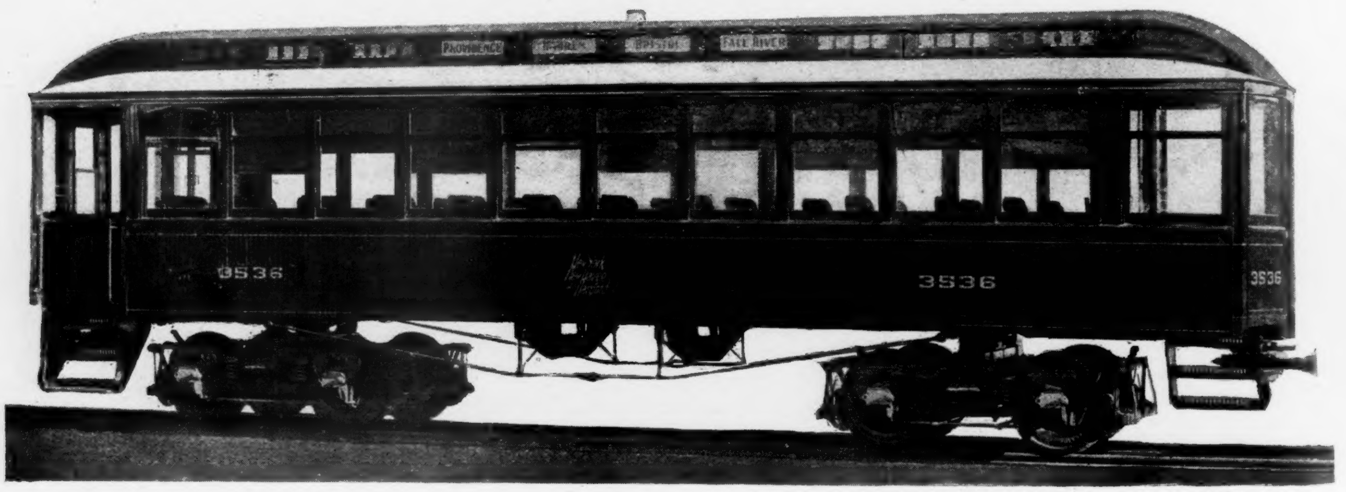
Another and entirely different development is that of the equipment of suburban electric roads, where it is necessary to provide much heavier and more capacious cars than have ever before been used in other than steam road equipment. Naturally this advance was based on the old horse car, which was made larger, heavier and stronger for the new power. This equipment, with relatively short and light cars, admirably answers the requirements of large cities, but for longer distances and interurban service greater capacity, more power, and greater strength were required. At the present time cars for such work have reached a length of 60 ft. They are light in the body and also the trucks. They often run on fast schedules which closely resemble those of the steam roads, and from a careful consideration of these facts we raise the question whether this is not the better line of development of the two. It is apparent that electric roads have met the ideas of the public in suburban transportation methods better than the steam roads, and this is not alone due to the favorable character of the power. In fact, in order to compete with parallel electric lines, steam roads need to take several leaves out of the electric book.

In this connection two types of cars recently built by the J. G. Brill Company, of Philadelphia, are interesting. The first is a 34-ft. car for the Utica Belt Line. This car is 34 ft. 4 ins. long by 8 ft. wide, with platforms 4 ft. 8½ ins. in length from the panel over the dasher, making a total length of 43 ft. 9 ins. The trucks are the Brill No. 27, with a wheel base of 6 ft., which have been illustrated in this journal. The sills of the car are lined with ½ by 12-in. steel plates, and the ends are fitted with angle-iron bumpers. The windows are protected by three iron rods at the corners and the sash cannot only be raised and lowered as in steam car construction, but may be slid up out of the way in the roof. This style of construction, which is known as the Brill patented semi-convertible car, does not convey with the actual operation of the windows all the advantages which it possesses. Owing to the fact that the windows when open are raised into the roof the necessity for framing in the inside walls a pocket for the reception of the sash is entirely eliminated. As a consequence, while the exterior width of the car is preserved, the interior width is increased by 7¼ ins., to the comfort of the passengers, and providing an increase in the width of the aisle. The Brill semi-convertible feature therefore provides in a narrower car practically the same room as in the standard steam railroad coaches of to-day.

The seats have corner handles ,and straps are omitted. At



Large Electric Car for Utica Belt Line—J. G. Brill Co.



Trailer Car for New York, New Haven & Hartford Railroad. Providence, Warren & Bristol Line.

the front end of the car is a partition enclosing four transverse types of its class. And we are informed by the Brill Company that fully 80 per cent. of their present orders for inter urban cars cover the same character of car that we have explained above—that is, the Brill patented semi-convertible car. The hoods are of plain clam-shell pattern, and the monitor deck is light. It is designed to meet all of the conditions of modern interurban electric service. Its weight is 42,565 lbs., complete with trucks and four motor equipments. The trucks, with motors, weigh 12,000 lbs. each.

Another and entirely different construction is that of the cars for the New York, New Haven & Hartford, for use on the electric line between Providence, Warren, Bristol and Fall River. These cars are 31 ft. 6 ins. over the bodies, and 40 ft. over the buffers. They have 24 36-in. walkover seats, covered with imitation leather, without arm rests, and have adjustable foot rests. Externally the appearance is like that of steam cars, with straight sides and needle beams. They are carried high enough to require three steps. The entrances are at diagonally opposite corners. These cars are similar in most respects to those which carry motors, and are mounted much higher than would be required for most electric roads. With the exception of the vestibules, the interior style and finish are in accordance with the practice of the road. One of these, for the motorman, is glazed, and the other is ceiled up. This car is a combination of the practice of steam and street car practice, with modifications for electric service. Its weight is 35,500 lbs. with trucks, but without motors.

METAL HOSE.

The successful and economical conveyance of hydraulic or pneumatic power or destructive or dangerous liquids by the use of flexible steel and copper pipes is an art which has been little understood in this country. The American Metal Hose Company's hose product constitutes an apparently reliable and practically indestructible substitute for rubber hose, combining as it does, the durability of metal with the flexibility of rubber. Metal hose, in consequence of its construction and the material employed, is practically impervious to the influence of destructive fluids, and is therefore adapted to the conveyance of steam, compressed air, water, oils, acids, alkalies, benzine, gasoline, naphtha or gas. Heretofore metal hose has been known as flexible metallic tubing. This tubing is quite different from metal hose, in that the former consists of a single tube, which can only be satisfactorily used where it is not hauled, twisted or subjected to hard usage. It has, therefore, not come into extended use. This tubing has been made in England and France.

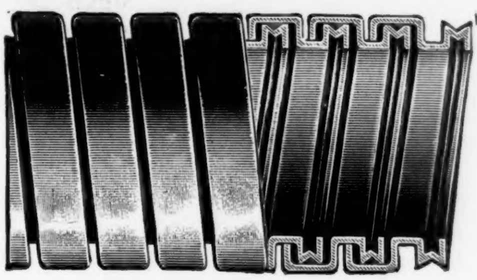


Fig. 1.—Single Metallic Hose.

The invention known as double metal hose is not an india rubber tube enclosed in metal. It is constructed of metallic tape, which is rolled up in the form of a spiral so that the edges overlap and fit tightly into each other, without detracting from its power of motion. As the tape is rolled up it forms a groove for the reception of a packing which is entirely enclosed in the metal as it rolls, and where it remains protected from internal or external wear and tear. This packing makes the hose perfectly tight, while the jointing produces a flexibility superior to rubber hose of equal dimensions. As the hose will not kink or crush, it delivers its full capacity and gives a larger opening than does rubber hose of equal external diameter. Couplings and connections being made from outside leave the internal diameter constant.

Metal hose is made according to several systems. In one of these the packing is of rubber and lies between the overlapping edges of the tape. This hose is only for light work where there is not much pressure. In another system, shown in one of these engravings, the packing is of asbestos. It does not lie between the overlapping edges as in the first system, but is held firmly in a groove of the tape. A third method is the double hose, which is shown in the second illustration. It is made of two tubes, one within the other, and firmly fastened at the ends. The coils of the tubes are turned in opposite directions. The double coil prevents this form of hose from becoming untwisted, by careless handling or great strain, as may happen to the single coil hose. The double tube hose can be made, for special service, capable of withstanding a pressure of 3,000 lbs. per square inch. Its uses are varied. It can be used for conveying steam at any ordinary pressure. It is used for blowing flues, for rock drills, and is serviceable on railroads, in roundhouses, shops, mines, tunnels, etc. For conveying greasy liquids, which destroy rubber, this hose gives the best results, as its flexibility is increased by the lubricating quality of the liquid passing through it, and its life is consequently prolonged. This is known as the Witzenmann system.

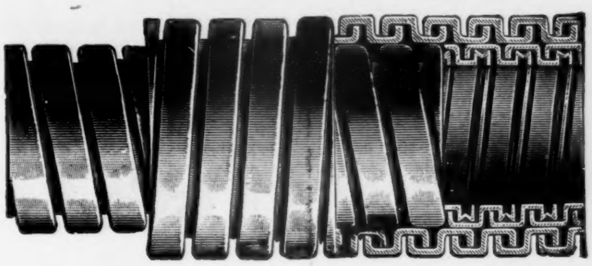


Fig. 2.—Double Metallic Hose.

Further information may be obtained from the American Metal Hose Company, 425 Dickey Building, Chicago, Ill.

Since the recent sad accident in the New York Central tunnel a number of signaling schemes for exhibiting lights in locomotive cabs have been brought to public attention and their inventors have been quoted as promising perfect protection from collisions by such apparatus. Inventors should have proper encouragement, but in this case they should be brought up quickly to the point of proving reliability in the apparatus which is to carry such heavy responsibilities. Suggestions of signal lights and audible signals in locomotive cabs and automatic safety stops for working air brakes are not new. They possess features which are desirable, but it will require years of successful operation to convince experienced signal officers that the locomotive, as it is operated today, can safely be made a part of a signaling system. Railroads have not proved their appreciation of signaling with existing devices by a degree of attention in maintenance which gives promise of the better care which such a device as an insulated truck under a locomotive tender will require, and until this has been done we are prepared to maintain, vigorously, the position that the locomotive should be kept free from these additional complications.

SHIMER CUTTER HEADS.

The cutter heads here illustrated are the latest improved form made by Samuel J. Shimer & Sons, of Milton, Pa. These cutters have been improved in many ways. Solid steel forgings are now used instead of bronze, for the heads. They are made with four, six or eight bits, each set placed in what has been found to be the best cutting position for speed and general efficiency. The cuts show the heads with four bits, and the latest form of expansion movement. So accurate is this feature of the device that by turning the adjusting ring until it snaps one notch, the cutters can be expanded or contracted the thickness of tissue paper. A quarter of a turn, or three notches, will change the size of tongue or groove 1/64th of an inch, and a full turn will change them 1/16th of an inch. The great advantages of this rapid method of adjustment will be readily apparent when it is remembered that any particular tool, set of bits or knives will not make the tongue and groove alike in all kinds of wood. The bits rest within conical duplex bit seats to line up their cutting edges to under-cut and over-cut, with clearance for single tongue and groove flooring, ceiling, siding and wainscoting. Every part of the cutting edge of these bits is protected with clearance and a new cutting edge is brought full and sharp at each filing and setting of the bits. The cutter head is protected against injury, if the driving belt should break with the feed on, by reason of the concave bit seats which are provided; brass heads with flat seats, have often been injured by such an accident. The strength of the heads and this concave feature in the bit seats makes these tools practicably indestructible. The concave seat, with its duplex incline, includes another good feature. It is that the bit tapers both ways from its largest diameter, when the heaviest in-cut is made, and shaves away the chip from a dividing line, up and down, giving to these leading parts a diamond-shaped tool point. Another good feature is that the bits which cut the upper half of the tongue and groove are placed upon the lower section of the head, which carries the top adjusting screw and remains a fixture in line with the set of the cylinder. Further information may be had from the manufacturers.

The Shimer Cutter Heads with Four Bits and Expansion Device.

Impact tests on notched specimens are extremely effective in showing brittleness or lack of homogeneity in structural steels. A notched bar under impact tests yields in an entirely different way from an unnotched one. There is as yet no general agreement as to the best form and depth of the notch. These matters were discussed recently by the International Association for Testing Materials of Construction at Budapest. One method is to use test bars of .314 in. by .393 in., having a sawcut 1 mm. deep and rounded at the bottom; V notches were advocated by other members. There is a general consensus of opinion, however, that the height of the fall should be such as to cause rupture at one blow. In experiments conducted by M. Barba specimens 11.8 ins. by 1.18 in. were used, and were V-notched, the angle of the sides being 45 deg. It is important that the radius of the point of the V should not be greater than 1/125 in. In testing, the bars are gripped between jaws, the notch on the top being vertically over the edge of the lower jaw. The piece, 25 mm. long, projecting from the jaws, is then struck by a falling weight if 39.4 lbs., moving between guides. The weignt strikes .866 in. away from the center of the notch. The height of tne fall is adjusted by trial, so as to just insure fracture. These tests detect brittleness, as well as a lack of homogenity in a specimen. In order to avoid the time lost in the trial and error method for finding the proper height of fall, M. Tremont devised a machine in which the "tup," after breaking the bar, is received on springs which register the energy remaining in it. The height of the fall is purposely made too great, and the work done in breaking the bar is found by subtracting the remaining energy in the tup after fracture, from that in it at the moment of striking.

M. Barba found that annealing ordinary steel does little to correct a tendency to brittleness, but tempering does. Confirmation of this fact has been forthcoming in some experiments made on shafting steel used for French warships, by M. Godard, Ingenieur de la Marine at Indret. The height of fall needed for fracture with the annealed specimen was only 10 to 20 millimeters, while the tempered specimen did not break with a fall of 3.55 meters.

A simple and inexpensive method of waterproofing blue prints is given in "Mines and Minerals." It renders them completely impervious to water, and will be appreciated by those who have experienced the annoyance of having the prints discolored and blurred by rain, drippings or moisture in general. The waterproofing medium is refined paraffin, and may be applied as follows: Immerse in melted paraffin, until saturated, a number of pieces of an absorbent cloth a foot or more square, and when withdrawn and cooled they are ready for use at any time. To apply to a blue print, spread one of the saturated cloths on a smooth surface, place the dry print on it with a second waxed cloth on top, and iron with a moderately hot flatiron. The paper immediately absorbs paraffin until saturated, and becomes translucent and highly waterproofed.

THE EXCESSIVE TONNAGE EVIL.

"Heavy train tonnage," says Mr. G. W. Turner, in a recent issue of the "Railway and Engineering Review," "seems to have been adopted by a number of railway companies as the stepping stone toward economy." True economy, however, as the writer of the article proves, is not always obtained in that way.

It looks very well on paper to see trains run from terminal to terminal with maximum tonnage, but the reason it looks so well is that bad delays are not shown and a heavy engine repair bill, due to overloading, is altogether excluded from the statement, and even trains which make a very bad record are dropped out of sight so that the average may be kept up, on paper. In reality it is impossible to successfully handle "the limit heavy tonnage trains" without greater proportionate expense, and an almost inevitable freight blockade to follow. Shippers wonder why there is a car famine or a lack of power to move their goods promptly, especially where new equipment has been added.

The writer gives his experience of the effects of this train-tonnage craze on a certain trunk line upon which he was employed. He says: "We were doing an enormous freight business and were taxed to our utmost with the power we had, to keep the road from being blocked, when the mandate was issued to load trains to the very last notch. Protest was useless, and the result was a freight blockade. The powers above, believing this had been caused by shortage of power, gave us 25 new engines and a lot of new cars, but the situation did not improve, in fact it became worse. Had we been furnished with 250 engines, working under the heavy tonnage system, the road would still have been blocked. The management, however, went to the other extreme and ran ridiculously light trains in order to relieve the congestion.

"To satisfy ourselves, I persuaded my superintendent to try an experiment on the quiet. Our business was such that we were able to make an experiment. We took two new 20 x 26 engines of the same class; we put one on a drag freight train giving the limit, 60 loads; the other was put on a faster freight with 40 loads. This was done on a 125-mile district. A 90-day test was made, and from this a year's average performance was computed. The one hauling 60 loads took an average of 12 hours on the road. She was held at each terminal an average of five hours for flue work and other necessary repairs. In other words, she was 34 hours making a round trip. She lost 15 days for engine failures complete; 35 days held in for work; 21 days through the shop for general repairs. That left 294 working days, or 7,056 hours. Dividing this by 34, we found she had made 207 round trips and had hauled 24,840 loads. At $16 car revenue, she had earned $397,440.

"The other engine made the round trip in 20 hours; she lost 21 days for general repairs, one day for engine failure; was held in three days for work. She worked 240 days, or 8,160 hours, and had made 408 round trips, hauling 32,640 loads and earning $502,400. That is $104,960 better than the heavy tonnage engine. Looking at this test, fairly made over a division having 14 daily passenger trains and countless freight trains, the drag train did well to make the trip in 12 hours.

"It has been estimated that a box car kept moving will earn $3 per day. By reason of the slow time made by the heavy train nearly 8,000 cars were tied up, which, at the figure quoted, means a loss of $24,000 on a 125-mile district. Suppose the road was 2,500 miles long, it would show a loss of $480,000 on equipment, with untold losses on account of revenue being driven from the road. It would not take many of these drag trains to spoil the dividends. Still it is kept up."

One of the arguments against lighter tonnage trains is "Look at the cost of running more trains, with more trainmen to pay, etc." The answer to is the single item saved on equipment due to quick movement will more than offset this. The overtime paid on drags, repairs, etc., on a large system would soon build a railroad, and if heavy tonnage were made the exception and not the rule, handsome returns would be the result all round.

THE 20,000TH BALDWIN LOCOMOTIVE.

The Baldwin Locomotive Works celebrated their seventieth anniversary February 27, and the completion of the twenty-thousandth locomotive built by them. As the event occurred after this journal went to press we must be content to merely announce the fact at this time and give an account of the occasion later.

The history of these works is contemporaneous with that of steam railroads in this country. Mathias Baldwin, the founder of these works, was a jeweler, and about 1830 constructed a model of a locomotive for exhibition in Philadelphia. This led to an order from the Philadelphia, Germantown & Norristown Railroad for a locomotive to replace horses for car traction. His only guide with reference to the details was obtained by an inspection of an English locomotive ,then running on the Camden & Amboy Railroad. In 1832 the "Old Ironsides" was completed and put into service. Its cylinders were 9½ by 18-in., it had but four wheels, and weighed 5 tons. The boiler was 31 ins. in diameter, and had 72 copper tubes ½ in. in diameter and 7 ft. long. An interesting model of this historic engine may be seen at the Baldwin Locomotive Works, where it is carefully preserved.

In 1834 five locomotives were built, and in 1835 the works were moved to their present location. In 1835 fourteen engines were built; 40 were built in 1836. After some financial troubles the business began to develop on a firm basis in 1842, and these works after that date grew with the railroads.

The works as they stand to-day are very largely a result of the sagacity and skill of Mathias Baldwin, and they constitute a monument to his efforts. He died in 1866. The building of the first thousand locomotives at these works occupied thirty years, being concluded in 1861. Since that time 19,000 have been built, and the celebration of this achievement will be appropriate and impressive. It is interesting to study the character of this twenty-thousan..n locomotive from the engravings which we publish in this issue. It is fitting that this particular engine should be of unusual interest, and if, (as we confidently expect it to do), it marks a turning point in locomotive practice in this country, this celebration of the Baldwin Locomotive Works will have a large place of its own in the history which is yet to be written.

A feature of the celebration was the assemblage of notable men, and we are of the opinion that this indicates a growing appreciation of the part which the locomotive is to play in future railroad development.

SPEED OF EXPRESS TRAINS.

By C. M. Muchnic.

Till quite recently American trains held the supremacy in speed over any other trains in the world. That our fastest trains are now only second in the line of fast trains will be evident from an examination of the tables below, published by the "Archiv für Eisenbahnwesen." These tables show the speeds of regular trains run in France, the United States, England and Germany during the summer season of 1900, giving the mileage between terminal stations, number of stops, hours consumed per trip and average speed of train per hour.

Comparing the two fastest trains, viz., the Paris-Bordeaux, with a stretch of 363.5 miles, and the New York to Buffalo express (Empire State), with a stretch of 439.9 miles, it will be seen that the former train, with an equal number of stops (4) covers the distance at an average speed of 56.5 miles per hour or 2.5 per hour faster than the Empire State Express at

an average speed of 54.0 miles per hour. For short distances the fastest trains will be seen to be the Philadelphia & Reading and Pennsylvania expresses from Camden to Atlantic City. The former covers the distance of 59.3 miles in 53 minutes with no stops, at a speed of 67.2 miles per hour, and the latter covers the distance, 60.3 miles, including one stop, in 59 minutes, or at a speed of 61.4 miles per hour.

The American trains are heavier than the European, but it is also true that the American engines that haul these heavy fast passenger trains are from 25 to 40 per cent. more powerful than their European mates. Those who are accustomed to see the powerful American engines and have had occasion to observe the performance of those smaller French engines are led to do some thinking.

Two conditions seem to be essential in the fast passenger engine. First, as powerful a boiler as can safely be carried on the wheels, and second, the reduction to a minimum or total annihilation of the dynamic effect of the reciprocating weights. A study of these engines will show how much the designers of these French express engines have sought to meet those two conditions and how closely they have reached their solution.

To obtain the highest boiler efficiency with a minimum weight they have adopted the compound principle. Mr. de Glehn claims that any modern high-pressure locomotive boiler will be 25 per cent. more efficient or powerful when furnishing steam to compound cylinders than to simple expansion cylinders. The second condition is realized by arranging the compound cylinders and working of their respective pistons in such a manner that their reciprocating weights counterbalance each other, thus producing the balanced engine. It is because of these two conditions or features, noticed on almost all European express locomotives, that such high speeds, combined with an economical performance, have been attained.

SPEED OF EUROPEAN EXPRESS TRAINS.

Line.	Distance in miles.	Hours consumed per trip, stops included.	Number of stops.	Hours consumed per trip, stops deducted.	Av. speed per hour.
France.					
		h. m.		h. m.	
Paris, Erquelines	149.1	2.49	2	2.44	54.7
Paris, Mons	155.3	3.35	2	3.11	48.7
Paris, Amiens, Calais	185.2	3.30	0	3.30	53.0
Paris, Arras, Lille	153.5	3.00	3	2.52	53.7
Paris, Rouen, Havre	141.7	3.00	1	2.55	48.4
Paris, Tours, Poitiers, Bordeaux	363.5	6.42	4	6.25	56.5
Bordeaux, Hendaye	144.8	2.52	4	2.45	52.8
Tours, St. Nazaire	159.7	4.29	7	3.34	44.7
Bordeaux, Narbonne, Cerbere	318.1	8.15	8	7.10	44.1
Paris, Limoges, Toulouse	443.0	10.57	9	10.22	42.8
Paris, Nevers, Clermont	261.0	7.26	10	6.48	38.5
Paris, Dijon, Lyon	318.1	7.27	3	7.07	44.7
Paris, Macon, Geneve	389.0	10.14	7	9.38	40.3
Lyon, Marseilles	218.1	4.42	2	4.29	48.5
Paris, Belfort	275.3	6.08	4	5.48	47.2
Paris, Nancy, Avricourt	254.8	5.42	5	5.27	46.6
Paris, Frouard, Pagny	232.4	5.39	8	5.14	44.1
Paris, Reims, Mezieres	213.8	3.30	2	3.19	46.0
United States.					
New York, New Haven, Boston	232.4	5.00	3	4.49	48.4
New York, Albany, Buffalo	439.9	8.15	4	8.07	54.0
New York, Geneva, Buffalo	451.1	9.55	14	9.29	47.5
New York, Buffalo, Chicago	980.6	24.00	12	23.12	42.2
New York, Niagara Falls, Chicago	980.6	26.30	46	24.52	39.1
New York, Philadelphia, Chicago	913.5	24.00	16	23.07	39.7
N. York, Philadelphia, Washington	228.0	5.00	7	4.46	47.8
Chicago, Cleveland, Buffalo	540.0	12.55	15	12.19	44.1
Chicago, Detroit, Buffalo	523.2	13.40	19	13.04	41.0
Chicago, Baltimore, Washington	845.10	23.00	21	22.02	38.5
Chicago, San Francisco	2,420.3	69.30	39	67.21	36.0
Baltimore, Philadelphia	108.7	1.57	1	1.56	49.7
Baltimore, Cincinnati, St. Louis	934.6	28.35	41	27.01	34.8
Boston, Albany, Buffalo	49.9	13.00	9	12.17	40.4
Cleveland, St. Louis	548.1	13.45	22	13.07	41.6
Philadelphia, Atlantic City	60.0	1.00	1	.59	61.4
Camden, Atlantic City	59.0	.53	0	.53	67.2
England.					
London, Newcastle, Edinburgh	394.6	7.45	3	7.29	52.8
London, Leicester, Glasgow	425.0	9.05	6	8.40	49.1
London, Crewe, Holyhead	264.1	5.15	1	5.10	50.9
London, Bristol, Plymouth	247.3	5.18	2	5.00	49.7
London, Harwich	69.0	1.27	0	1.27	47.8
London, Dover	76.4	1.41	0	1.41	45.3
London, Southampton	78.9	1.45	0	1.45	45.4
Edinburgh, Aberdeen	130.5	3.17	5	3.08	41.6
Dublin, Cork, Queenstown	177.1	4.25	3	4.06	43.5
London, Crewe, Glasgow	402.0	8.00	4	7.48	51.6
Germany.					
Berlin, Hamburg	177.7	3.36	1	3.32	50.3
Altona, Kiel	65.2	1.37	1	1.35	41.0
Berlin, Stralsund	149.7	3.52	3	3.42	40.4
Berlin, Dirschau	264.7	6.26	5	6.09	42.9
Dirschau, Konigsberg, Eydtkuhnen	225.6	4.52	3	4.41	41.6
Berlin, Schneidemuhl, Thorn	238.0	5.34	4	5.18	44.7
Berlin, Breslau, Oderberg	316.9	7.27	6	7.07	44.7
Breslau, Dresden	165.3	4.22	7	4.04	40.4
Dresden, Leipzig	98.2	1.43	1	1.42	42.2
Berlin, Leipzig, Hof	209.4	5.02	2	4.54	42.9
Munich, Salsburg	95.1	2.17	0	2.17	41.6
Hamburg, Munster, Cologne	278.4	6.48	11	6.22	43.5
Berlin, Halle, Frankfort	374.4	8.50	10	8.24	41.0
Leipzig, Madgeburg, Hanover	165.3	4.27	5	3.54	42.3
Berlin, Stendhal, Hanover	160.9	3.42	2	3.37	44.7
Berlin, Madgeburg, Hanover	179.6	4.15	4	4.00	44.7
Hanover, Essen, Cologne	201.3	4.51	4	4.40	42.3
Berlin, Hildesheim, Cologne	357.9	9.21	14	8.46	41.0
Cologne, Bingerbruck, Frankfort	137.9	3.40	4	3.20	41.6
Cologne, Mayence, Carlsruhe, Bale	321.9	7.38	8	7.10	44.7
Frankfort, Carlsruhe, Bale	210.6	5.17	6	4.52	43.5
Luxemburg, Strasburg, Bale	208.8	6.00	13	5.33	41.0
Avricourt, Strasburg	109.4	2.49	2	2.39	41.0

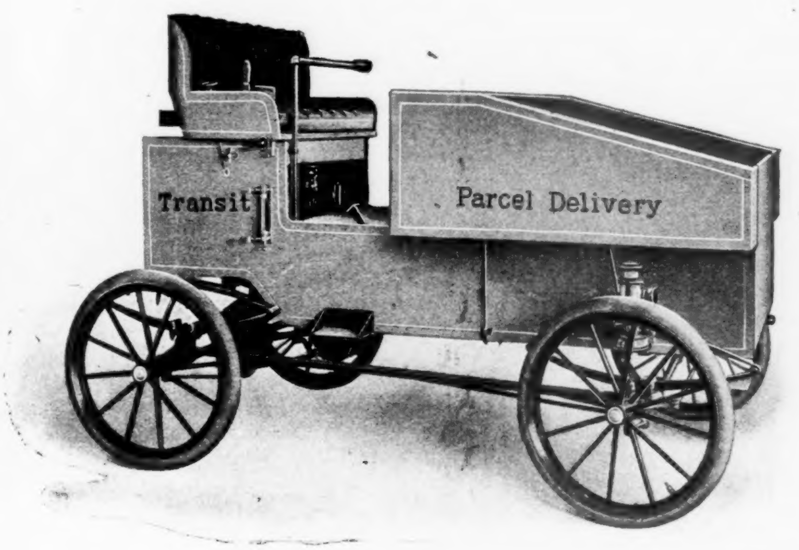
It is impossible to take diagrams from a steam turbine, therefore there can be no indicated power. A recent De Laval turbine test developed the fact that the theoretical and experimental values for steam consumption agreed within 1/10 of 1 per cent. The two turbines tested were each 100 horsepower. The pressure was 172 lbs. and saturated steam was used. For a run of 4½ hours, with a condenser pump, almost 18 pounds of steam were used per effective horse-power. Without the pump the consumption was 16.92 lbs. By making a deduction of 10 per cent., to reduce these results to those of highly efficient steam engines, it will be seen that the turbine is quite as efficient a machine as the reciprocating engine of the same power. The turbine is especially adapted for use with superheated steam, since there are no rubbing surfaces, no valves to keep tight, and no lubricants to become carbonized by heat. A test made at the Technical High School at Dresden proved that an economy of 30 per cent. was effected by the use of steam superheated 336 deg. C. The high temperature of the exhaust steam makes it desirable for heating feed water.

There is, generally speaking, a sufficient traffic, properly conserved, to maintain fair returns upon all our railways. The service, especially in freight traffic, is so nearly uniform and there is such an increased identity of interest of each company as compared with its neighbor as to justify abandonment of the old idea of grasping everything in sight, and instead, a devotion primarily to the development of local and regular traffic and the making of the same effort to bring about, by concerted action, an equitable distribution of the more competitive traffic on broad lines, as between the several roads competing therefor, as was formerly expended in individual effort for purely selfish ends. Take as an illustration two great trunk lines. Eighty per cent. of the earnings of each are of the local or regular patronage character. How wise it would seem to be to establish an understanding for an equitable distribution of the 20 per cent., instead of an indiscriminate competition therefor which must, by the nature of things, draw into the demoralization a considerable part of the other business!—B. D. Caldwell, before New York Railroad Club.

We have been asked what differences exist between the fuel oils of the East and those of California. The Eastern oils are principally of hydrocarbons of the paraffin series, while those of California contain a greater proportion of hydrocarbons, having a greater percentage of carbon than those of the paraffin series. This large amount of carbon explains the reason for the principal value of California oils for fuel, because they are less adapted to refining for illuminating and other purposes. The California oils are productive of asphaltum, gas distillate, lubricating oil and naphtha, but their greatest value is for fuel.

A NEW MOTOR CAR.

This vehicle is worthy of the attention of our readers, especially because it was developed and built by a railroad man of wide experience, Mr. W. S. Rogers, who designed it with reference to the needs of railroad officers for inspection cars. The one now completed is for road use as an "automobile," but with the substitution of flanged wheels and a rigid front axle the same machine is to be used for inspection service, as the gauge is 4 ft. 8½ ins. The engraving shows the construction for distributing parcels on city streets. By the removal of the parcel box and substitution of a seat box tne carriage becomes a passenger vehicle. It was built at the Steamobile factory at Keene, N. H., and has been called the "Transit." It has been fitted with the Steamobile Company's special two-cylinder 6-h.p. engine, and steam is generated in a straight shell boiler with 428 ½-in. tubes, 13 ins. long. The fuel used is gasoline, which is stored in a tank of 12 gallons' capacity,



A Motor Car for Road Use and Railroad Inspection Service.

while the water tank holds 36 gallons. The weight of the "Transit" is 1,400 lbs. in working order. It is mounted on four 28-in. wheels having 3-in. rubber tires, and its wheel base is 6 ft.

As a parcel delivery vehicle it is of very convenient form. The operator's seat is at the back, and is no higher than that of the present type of motor cars, and though the parcel receptacle is in front, it is low enough to afford the operator an unobstructed view of the road in front. Parcels and goods carried cannot fall out and are at all times under the eye of the man in charge. This parcel box can be removed and the vehicle turned into a passenger conveyance if desired. When this is done the parcel holder is replaced by a comfortably upholstered passengers' box, which will normally seat four persons, though five or more can ride pleasantly, at a pinch. The "horseless" feature of this carriage is emphasized by the fact that the entrance for the passengers is directly where the tail of the horse would ordinarily be. The passengers, though sitting with feet but 18 ins. from the ground, nevertheless have an excellent view of everything about them, and this without interfering in any way with the operator. The front position of the passengers protects them from annoyance from steam, gas fumes or dust.

This vehicle might be very useful in the service inaugurated by some of our leading railroads, and be employed in the conveyance of passengers from station to hotel or residence, and vice versa. It would make an ideal delivery wagon for hand baggage and small articles, in the same service.

Wire-wound cast-iron pipe.—M. Jacquemart, the managing director of the Société Metallurgique d'Aubrives et Villerupt, France, has introduced the system of winding steel wire, under pressure, round the extremities of the pipe and in grooves cast in the body of the pipe. The idea of shrinking iron bands onto cast-iron cylinders is very ancient, but the problem was to find some method which would cause the bands to follow exactly the shape of the parts to be enveloped, and exert an even pressure throughout. This is accomplished by the method of winding above referred to. In the manufacture of pipe all complicated machinery must be rejected, and it was therefore essential to provide a method of winding which, while being perfectly simple in its application, would secure perfect uniformity of tension in each wire wound round. M. Jacquemart started from the fact that a steel wire of uniform diameter has a constant resistance throughout its length. He devised a method by which the wire is passed through a drawplate, which reduces it to a certain fixed diameter. Winding at an equal and constant pressure is effected by revolving the pipe, the wire first passing through the drawplate above described under the desired amount of tension. Another important point is the bedding of the ends. This is effected by shaping the edges of the grooves so that the wire can be bedded into them, and thus be securely fixed; and for greater security molten tin is poured over every end. Asphalt is put on at high temperature, which penetrates the spaces between the coils and completely covers them. Experiments with these steel-bound pipes indicate that with them it is possible to avoid a burst with a large main. Their behavior under such conditions as sudden and instantaneous shocks shows that pipe of this type is proof against a burst, and that even when strained to the point of fracture the damaged parts remain in their original position. A cast-iron main of this type 78 in. in diameter has been laid by the water company of Paris.—The "Mechanical World."

Cylinder brakes of the Le Chatelier type receive renewed interest with the increasing weights of locomotives which are used in mountain service. Recently the Baldwin Locomotive Works have developed a new brake of this character, illustrated on page 12 of our January number, which has been extensively applied on the Atchison, Topeka & Santa Fe, the Colorado Midland and other roads having heavy grades. With these brakes as auxiliaries the engines are operated on a down grade with the driver brakes cut out, the reverse lever in full back motion and the brake resistance of the cylinders is regulated by a valve at the hand of the engineer, whereby he controls the amount of air which is pumped by the cylinders. Mr. Vauclain says: "It is surprising how uniformly one can bring a passenger train down those long grades without applying the brakes to the car wheels. The serious business of running passenger trains—also freight trains—on long steep grades is that the tires warm up, the brake shoes get red hot and cast-iron wheels sometimes burst, making the wear and tear on the wheel equipment very severe. But with this device and this locomotive, we were able to bring train after train down those grades without any assistance from the train brakes."

Mr. Charles B. Young has been appointed mechanical engineer of the Chicago, Burlington & Quincy Railroad to succeed Mr. F. H. Clark. Mr. Young has been chief draftsman of this department for a number of years, and succeeded Mr. Clark in that position.

RECKONING TONNAGE OF PASSENGER TRAINS.

On the Ton-Mile Basis.

In order to answer a recent inquiry concerning methods of figuring the tonnage of passenger cars, as to whether it is customary to use the actual weights of the cars, information was secured from four roads which may interest our readers.

On the first of these, when the ton-mile basis was first put into effect, blue prints were prepared for the car accountant's office, in which the ton mileage was computed. On these prints the different classes of passenger cars were grouped, each group containing the number of cars of the same class or of the same weight, the weight of the empty cars being given by weighing a few of each class. For example, one group contained the numbers of all the 12-wheel vestibuled chair cars weighing 40 tons. Another group contained all the 8-wheel vestibuled chair cars weighing 30 tons, and so on. The clerks of the accountant's office soon knew all of these numbers and it was necessary only occasionally to refer to the print. As the passenger cars went through the shops from time to time they were weighed, and in this way the actual weight of all of them was taken. This gave an opportunity to keep track of the increase of weight of any of the cars by adding vestibules or enlarging water reservoirs, and to keep the record up to date. It was found, however, that unless radical changes were made the original weights were quite close.

On another road the weight of the passengers and baggage is taken into account, on the assumption that each passenger and his baggage weighs a definite amount, say 180 lbs. Of the exact weight taken we are not sure, and the number of passengers is obtained from the reports of the conductors. These weights are added to the known weights of the cars.

A third road uses the scale weights of all the different classes of cars and adds to these two tons to each for passengers, while to the weights of baggage, mail and express cars five tons are added for their contents. A fourth road adds three tons to the scale weight of every passenger equipment car for passengers, baggage, mail and express, the varying weights being considered as averaging this amount.

VALUE OF TECHNICAL JOURNALS.

To those who watch the progress of men the importance of keeping thoroughly informed is clearly understood. The most successful men in all professions and occupations are usually those who closely follow the work of others as recorded in the technical papers of their special work. A letter recently received from an old subscriber, a blacksmith, contains a valuable suggestion to young men, no matter what their field, and it is printed in full for their benefit, as follows:

"For the past 28 years I have been foreman of the boiler and blacksmith shops of one of the leading railroads of this country, and, in leaving this work, it is only fair that I should say that the greatest assistance I received in my work was the information derived from the American Engineer and Railroad Journal, the American Machinist and other technical papers. I can truthfully say that the ambitious young man whose work lies along these lines cannot obtain greater assistance than the information contained in such journals, which, when properly utilized, will equip him to fill any position in his chosen work to which he may be called.

'Because of leaving the field in which I have so long worked, for another, entirely different, it is necessary for me to study the new subject in the same way, by aid of the best publications which are devoted to it. I therefore reluctantly cancel my subscription to your paper."

Mr. Clarence P. Day, 253 Broadway, New York, has inaugurated a unique service in connection with advertising. He acts as advertising counsellor, and from his intimate knowledge of the publishing business and thorough acquaintance wi... advertising methods is prepared to assist in securing the best results from a given expenditure. He stands for the better value of good advertisements in a few of the best papers as compared with small and passive cards in many, which are selected without the benefit of the discrimination which the expert only can use. The American Engineer endorses Mr. Day and his service, and urges advertisers to consult him.

While the mechanical departments of the American railroads are being crowded in the matter of capacity of locomotives, and with the present tendency will find it difficult to meet the requirements for power, it is clear that in the capacities of cars they are far ahead of the present abilities of the operating departments in the loading of the cars. The increase in capacity of the freight car has not been accompanied by a corresponding increase in the loads carried, and considerable improvement will be necessary before the increased cost of 40-ton above that of 30-ton cars will be earned. A competent authority places the actual loading of cars at not above 55 per cent. of their nominal capacity, considering the railroads of the country as a whole. It is only in grain, coal, ore or similar traffic that full loads are always insured, but by careful watching of the loading at local points, the average of miscellaneous freight will gradually be raised. There is now a great waste of equipment, and the benefits to be derived from increasing car loadings will be apparent at once. They will appear in decreased car mileage, decreased train mileage, switching cost, and in increased earning capacity of the entire road, because of the more profitable use of facilities. The present situation is not in the least an argument for smaller cars; it is the strongest argument for larger ones, because it shows the deficiencies in present methods of loading.

BOOKS AND PAMPHLETS.

"Power and Power Transmission." By E. W. Kerr, Assistant Professor of Mechanical Engineering, Agricultural and Mechanical College of Texas. 8vo, 356 pages; illustrated. Published by John Wiley & Sons, New York, 1902. Price, $2.00.

This book covers in a small space a large part of the subject of mechanical transmission of power, and it would be impossible to treat one out of a dozen of its most important topics properly in a work of its size. It is intended as an outline, an indication of principles, and as a course of study. The reviewer cannot help feeling that it will give a superficial view of machine design, steam power transmission, the steam engine and valve gear to those who do not enjoy the advantage of the author's explanations and research into the large question upon which he touches. The work is to be commended to those who are deprived from access to complete works on the various branches of the subject. The author states in the preface that it contains the subject matter of lectures delivered to students of the elementary principles of engineering, and its purpose was to direct the beginner along the proper course of study.

"Mill Building Construction." By H. C. Tyrrell, C. E. 40 pages, 6 by 9 ins., illustrated. Published by Engineering News Publishing Company, New York. 1901. Price, $1.

The earlier pages of this little book are devoted to discussion of the live and dead loads which must be provided for in the roof and floor systems of mill buildings. A diagram is given showing the weights of roof trusses for given spacing and working stresses. The floor construction is shown in several forms, including permanent concrete ground floors, fireproof floors and the slow-burning or factory type of floor. The details are not elaborate, but serve to suggest points of value for the designer. In general, it may be said that the details of construction for the framework, etc., appear to be borrowed from good practice. However, the book cannot be said to be more than a suggestion, and were there not such a dearth of literature in this now important field of structural engineering there would seem to be small justification for the issue of so meager a treatment of the subject. On the other hand, it is but fair to say that the author does not call his work a treatise,

and it must be granted that the book is well worth the price asked for it.

"Water Tube Boilers." By Leslie S. Robertson, New York. 1901. D. Van Nostrand Company. 170 illustrations; 213 pages, Price, $3.

The author of this book is thoroughly competent to present the subject, and in this work has placed in available form five lectures delivered by him at University College, London. Bertin's "Marine Boiler," which was translated by him, is the best work on the subject, but it is costly. Mr. Robinson's book is less elaborate, but serves its purpose admirably. He evidently has access to information from the British Admiralty and also received assistance from boiler builders. The first chapter is a historical description of the best known types of water-tube boilers brought up to date. Next comes a treatment of the general principles of boiler construction, with particular reference to water-tube boilers. This is followed by a chapter on circulation of water and hot gases, presenting the Yarrow experiments. After describing the most important types of water-tube boilers and discussing their weights and space occupied, the author gives a fair statement of the advantages and disadvantages of the type. It is an excellent book, describing practice and presenting that which has been well tried, including such features as automatic feed-water regulators.

The Proceedings of the Thirty-Second Annual Convention of the Master Car and Locomotive Painters' Association have been issued. The book contains a verbatim report of the papers read and the discussions which followed. It contains a great deal of useful and practical information. It can be had on application to the secretary of the association, Mr. Robt. McKeon, Master Painter of the Erie Railroad at Kent, Ohio; or from the Industrial Press, 9-15 Murray street, New York. The price is one dollar. The book contains, with index, 150 pages, and is of the M. C. B. standard size.

The Proceedings of the Eleventh Annual Convention of the Association of Railroad Superintendents of Bridges and Buildings for 1901 have just been issued. The meetings were held at Atlanta, Ga., in October. The reports of committees were, Method of sinking foundations for bridge piers in depth of water of 20 ft. and under; Passenger platforms, best material, and cost of same; Best method of operating turn-tables by power; Auxiliary coaling stations, best design, capacity, and method of handling coal; Water stations, best material for foundations, tanks, substructure connections, capacity, etc.; Is it best for railroad companies to erect their own steel structures, or to let manufacturers erect them? The best and most convenient outfit cars for bridge gangs, and the number of men constituting a bridge gang. The proceedings were issued from the Rumford Press, Concord, N. H. Mr. S. F. Patterson, of the Boston & Maine, Concord, N. H., is the secretary of the association.

"Golf in California" is the title of a small magazine devoted to the interests of the game on the Pacific Coast. In the January issue are descriptions and interesting illustrations of the most noted links, country clubs and winter hotels in California. The pamphlet also gives diagrams of the different links. The last four pages of the pamphlet are devoted to information concerning the Santa Fe Railway and its daily trains from Chicago to San Francisco, Los Angeles and San Diego.

"Steel Plate Fans" is the subject of Catalogue No. 134, issued by the American Blower Company, of Detroit, Mich. There are about twenty-four half-tones, showing the fans full housed and three-quarter housed. Details of fan construction, journal boxes, general dimensions, with capacity of fans and useful information concerning them, is given. This catalogue also contains a price list. It will be sent to persons interested upon application. The New York office is at 141 Broadway.

The Pond Machine Tool Company, 136-138 Liberty street, New York, has sent us a very tastefully executed catalogue containing information regarding its latest line of heavy, powerful engine lathes. The half-tones are excellent, and the description accompanying each contains information concerning the tool shown, as well as giving the principal dimensions. Fourteen machines are catalogued, beginning with a 28-in. back-geared lathe, and presenting 36, 42 and 48-in. triple geared lathes, up to an 84-in. machine. A four-tool shafting attachment, which can be applied to the lathe carriage, is shown. This device has four tool slides, independently adjustable. The catalogue will be forwarded to persons interested.

H. M. Treadwell & Company, of 95 and 97 Liberty street, New York City, have issued a catalogue which illustrates the character of their car-building work. The rolling stock here set forth shows the style of work done from 1876 to the present time. The catalogue is arranged with a half-tone perspective view of a car on one page, with dimensions on the opposite page. The concluding half-tones show an 80,000-lb. capacity high-side wooden gondola, with side stakes made of structural steel, built for the Baker & Whiteley Coal Company; also a wooden 60,000-lb. hopper gondola, for the Philadelphia & Reading Railway, carried upon Fox steel trucks; and finally, a modern Union Tank Line car. Treadwell & Company solicit inquiries for prices and general information, and will supply the catalogue upon application.

Mr. R. T. Crane, president of the Crane Company, recently made an extensive investigation in regard to the utility of an academic education for young men who have to earn their own living, and who expect to pursue a commercial life. In this connection he sent out letters of inquiry to a large number of prominent business men throughout the country, as well as college presidents and graduates. The result of such investigation has now been published in pamphlet form for private distribution. Mr. Crane has published upward of fifty replies from persons prominent in college, railway and mercantile life. The pamphlet will be sent to anyone interested in the subject. It contains the opinions of some of the most successful business men of the country, and is valuable as well as interesting.

The Bradford Machine Tool Company, of Cincinnati, Ohio, has just issued a catalogue which contains descriptions of the various sizes and makes of the Bradford Lathe. After a brief general description, there follows, on alternate pages, cuts of lathes and the dimensions of their parts. The cuts are clear, and indicate the substantial construction of the tools which this company aims to maintain. About fifteen of these machines are here shown, including ordinary shop lathes; double back-geared lathes; coarse screw-cutting lathes; automatic power-feed turret lathes, and shafting lathes. The improved taper attachment given on page 23 appears to have considerable merit. The aim of the manufacturers is to give, in this catalogue, a concise view of the Bradford Lathe as it is made to-day by them, after over sixty years of successful manufacture.

The American Blower Company, of Detroit, Mich., has issued a neat catalogue, which gives information regarding the "A B C" hot-blast heater. The heater consists of a series of steam-fed vertical coils which, when boxed in, form a very effective building warming apparatus. Through this box a current of cool, fresh air is driven by means of a fan operated either by a pulley, or directly from a small engine. Above the heater coil is a passage for cold air, the supply of which is regulated by a damper, so that the hot air may be diluted with cool air as circumstances may direct. In any case, fresh air is supplied to the building which is to be warmed. The catalogue has many good half-tones, and gives information relative to size, construction and operation of the heaters.

Patent improved drop hammers is the subject of a catalogue sent out by the Billings & Spencer Company, of Hartford, Conn. Hammers of 1,000, 1,200 and 3,000 lbs. are illustrated, and the details of trip lever, latch, head construction, pulleys, board guard and foundations, follow, with separate illustrations and notes. A dissected hammer is illustrated, each part being numbered and named for facility in ordering. An improved trimming press is shown, and also two heating furnaces. Some handy tools for use in changing dies are manufactured by this firm. The catalogue, which will be sent to interested persons, shows on the three last pages an almost infinite variety of forgings of iron and steel which may be formed under the B. & S. drop hammers.

The Railway Appliance Company has issued a small folder, which they call "Now and Then." It points out the state of affairs which can occur when a freight train, hard pressed by the "Limited," and miles from everywhere on a dark night, breaks in two, and the crew has no spare knuckle to couple up with again. The Gilman-Brown emergency knuckle has been designed for just such cases. It is not exactly a knuckle; it is really a tool, and may be carried in the caboose. The "R. A." car mover is another useful device, particularly about a yard. Its operation is simplicity itself; the power which applies the leverage clamps the bar to the rail, and the greater the resistance the tighter the grip. The Railway Appliance Company, of 680 Old Colony Building, Chicago, will furnish further information concerning these devices.

EQUIPMENT AND MANUFACTURING NOTES.

Mr. Charles F. Pierce has been appointed to the commercial staff of the Goodwin Car Company, with office at 96 Fifth avenue, New York City.

At the Wilmington shops of the Pullman Palace Car Company the private car "Olympia" has been equipped for the use of Prince Henry of Prussia with the electric light system of the Consolidated Railway Electric Lighting and Equipment Company. The interior decorations are of bronze and mahogany, the upholstery is of blue plush, the tapestry is brown and the curtains of brown silk. This is one of the handsomest cars ever built in this country. It is lighted in every room by electricity and ventilated by electric fans.

We are informed that the Ball Bearing Company, Boston, Mass., well known as manufacturers of ball and roller bearings for all kinds of machine construction, have moved their factory to Philadelphia, where they will enjoy exceptional facilities for handling their large and increasing business in the most expeditious and convenient manner. The company ask our readers to note that in future all correspondence should be addressed the Ball Bearing Company, 2322 Market street, Philadelphia, Pa.

Mr. J. B. Wilson has been appointed manager of the new Canadian offices of the Standard Pneumatic Tool Company. The business of this company in Canada has of late been so encouraging that an office has been opened at 103 Union Station Arcade, Toronto, Ontario, where a full line of "Little Giant" pneumatic tools and appliances, repair parts and accessories will be carried. In future, it is the purpose of this firm to ship all machines for Canadian customers direct from the Toronto office, thereby saving purchasers the inconvenience of making out manifests and of paying duty. The Standard Pneumatic Tool Company's general offices and works are situated at Aurora, Ill.

The Structural Steel Car Company has been formed in Canton, Ohio, with a capital stock of $500,000, with the privilege of increasing it to $1,000,000, to build cars at that place. Mr. Ellwood C. Jackson, of Wilmington, Del., is president. He is a son of the late Job H. Jackson, and was for many years an officer of the Jackson & Sharp Company. The other officers are: H. A. Cavanah, vice-president; A. S. Griffin, secretary and treasurer; J. R. Reed, general manager; H. H. Woodcock, general superintendent, and R. H. Hornbrook, engineer. The company was formed to build structural steel cars. The plant occupies thirty acres in a favorable location, and will start next month with a daily capacity of about twenty-five cars.

The spirit of the times in the matter of consolidation has been shown in the recent consolidation of the various interests of the Chicago Pneumatic Tool Company, and the acquisition by it of two modern plants, viz.: the Chisholm & Moore Manufacturing Company (Pneumatic Cranes and Hoists) and the New York, Franklin Air Compressor Company. The crane department is running full time on orders in hand, and the outlook in this department promises the working of a double shift. The compressor department is also very busy. The company reports that since its reorganization, orders for compressors, pneumatic tools and appliances, including cranes and hoists, for the first half of January, equals the total December business of last year. This includes an order for 80 tools received from the Cramp Shipbuilding Company.

The Magnolia Metal Company has removed to a commodious office building and factory at 113-115 Bank street, New York City. The factory is fitted with the most modern appliances. The company produces "Magnolia," "Defender," "Mystic" and "Adament" metals, and all grades of babbitt, as well as solders and railroad brasses. With factories at New York, Stirling, N. J., Chicago and Montreal, the company possesses unusual facilities for filling orders promptly.

The Leighton & Howard Steel Company is the name of the new company formed by Messrs. Geo. B. Leighton and Clarence H. Howard, which has secured control of the Shickle, Harrison & Howard Iron Company. The latter concern was originally formed for the manufacture of cast-iron pipe and structural shapes, and the new up-to-date cast-steel plant at East St. Louis will be devoted entirely to the manufacture of cast-steel railway specialties, such as Ajax trucks, Player car and tender trucks, body and truck bolsters, Davis driving-wheel centers, Leeds reversible pilot couplers and other similar devices which were made by the old company. Mr. Clarence Howard will continue his activity in connection with the new company, of which he is vice-president and general manager.

There is probably no appliance so generally used in mechanical works as rubber hose, and none which requires more constant replacement, not only because rubber is limited as to endurance, but because of rough usage which is unavoidable, especially in a shop or roundhouse. Many attempts have been made to protect hose by various methods and the problem has been attractive to inventors. This subject has been attacked in a practical way abroad with apparently good results, and a particularly promising product is now being introduced into this country. The American Metal Hose Company, 425 Dickey Building, Chicago, offers a metal hose which they guarantee to be practically indestructible and absolutely tight. The hose is made entirely of metal, and it is stated that it is more flexible than rubber hose of equal dimensions and is of about the same weight. When this company first placed its product on the market many engineers thought it was impossible to make a steam tight hose entirely of metal which would have the flexibility of rubber. This seems to be successfully accomplished. This is clearly shown by the large number of orders they have received from concerns who are using double metal hose. In the list of users of this hose we find large manufacturing firms and well-known railroads. Pamphlets will be furnished upon application.

The Patent Title and Guarantee Company, Inc., of 150 Broadway, New York, have come forward with a novel plan for the protection of patentees against infringement. The company has drawn up a contract, in which it agrees to fight infringement suits brought against its patrons. It offers a system by which the poorest patentee is placed on an equality with a powerful trust or wealthy corporation in a legal struggle. It proposes to pay its contract holders, in the event of successful litigation, the amount of award of damages in full if not exceeding the amount of contract, and to pay from 50 to 90 per cent. of all damages awarded by the court in excess of the amount of contract if these damages are collected. The company charges 2 per cent. per annum on the amount of protection applied for by the patentee—that is, 2 per cent. on the amount of whatever a patentee may estimate the damage to him would be from infringement. It is a kind of protection intended to prevent patents being rendered practically useless through successful infringement or from being wrested from their holders owing to inability to enter into a costly legal defence. A number of prominent manufacturers and business firms are given as among this company's clients. Recently an important suit was won by the Patent Title and Guarantee Company, by which Mr. I. M. Landes was awarded royalties aggregating $50,000,000 on his patents covering metallic curbing. There are said to be 400,000 property-owners in the United States who have infringed the patents, and who will have to pay 50 cents royalty per lineal foot in consequence.